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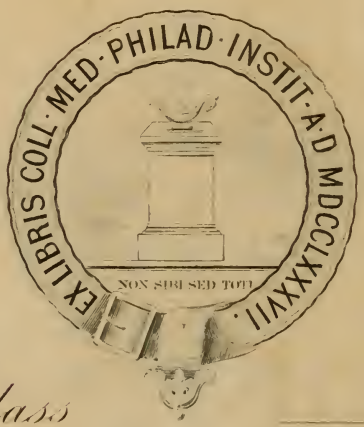

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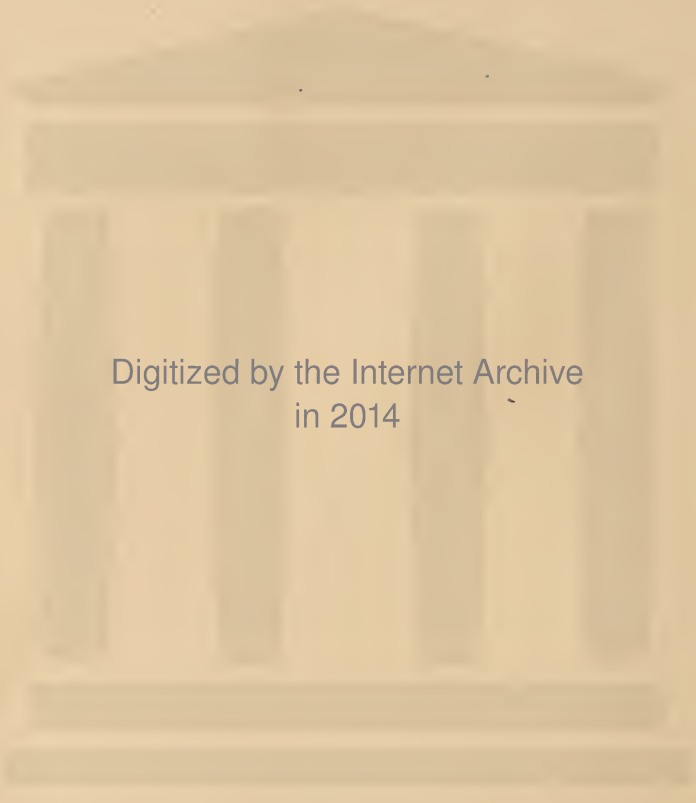

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TRANSACTIONS

OF THE

AMERICAN ORTHOPEDIC ASSOCIATION.

SEVENTH SESSION,

HELD AT ST. LOUIS, MO.,

SEPTEMBER 19, 20, AND 21, 1893.

VOLUME VI.

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LIST OF OFFICERS.

[Elected September 21, 1893.]

PRESIDENT.

A. M. PHELPS, M.D.

VICE-PRESIDENTS.

H. AUG. WILSON, M.D.
H. M. SHERMAN, M.D.

TREASURER.

E. G. BRACKETT, M.D.

SECRETARY.

JOHN RIDLON, M.D.,
103 State Street, Chicago.

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JOHN C. SCHAPPS, M.D.

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SAMUEL KETCH, M.D.

MEMBER OF EXECUTIVE COMMITTEE, CONGRESS OF AMERICAN PHYSICIANS AND SURGEONS.

NEWTON M. SHAFFER, M.D.
Alternate: AP MORGAN VANCE, M.D.

LIST OF PRESIDENTS.

1887. V. P. GIBNEY, M.D.
1888. NEWTON M. SHAFFER, M.D.
1889. E. H. BRADFORD, M.D.
1890. DE FOREST WILLARD, M.D.
1891. A. B. JUDSON, M.D.
1892. BENJAMIN LEE, M.D.
1893. A. J. STEELE, M.D.
1894. A. M. PHELPS, M.D.

MEMBERS.

* Original Members.
† Deceased.

1889. Bartow, Bernard, M.D. Clinical Professor of Orthopedic Surgery in the Medical Department of the University of Buffalo. 220 Franklin Street, Buffalo, N. Y.

1892. Blanchard, Wallace, M.D. Attending Orthopedic Surgeon to the Home for Destitute Crippled Children. 34 Monroe Street Chicago.

1889. Brackett, E. G., M.D. Assistant Surgeon to Out-patients, Children's Hospital; Physician to the Department for Nervous Diseases, Boston Dispensary; Assistant to the Department for Nervous Diseases, Boston City Hospital. *Treasurer*, 1894. 133 Newbury Street, Boston.

*1887. Bradford, E. H., M.D. Visiting Surgeon to the Boston City, the Children's, and the Samaritan Hospitals; Instructor in Clinical Surgery in Harvard Medical School. *Vice-President*, 1888. *President*, 1889. 133 Newbury Street, Boston.

*†1887. Brown, Buckminster, M.D.

*1887. Brown, Dillon, M.D. 40 East Fifty-seventh Street, New York.

*1887. Bryant, Joseph D., M.D. Professor of Anatomy and of Clinical Surgery. and Associate Professor of Orthopedic Surgery in Bellevue Hospital Medical College; Visiting Surgeon to Bellevue and St. Vincent Hospitals; Surgeon-General National Guard, S. N. Y. 54 West Thirty-sixth Street, New York.

1889. Burrell, Herbert L., M.D. Surgeon to the Carney and Children's Hospitals; Surgeon to Out-patients, Boston City Hospital; Demonstrator of Surgical Appliances, Harvard University. 22 Newbury Street, Boston.

1891. Cook, Ansel G., M.D. 55 Church Street, Hartford, Conn.

1893. Coolidge, Frederic S., M.D. Lecturer on Orthopedic Surgery in Rush Medical College; Attending Orthopedic Surgeon to the Home for Destitute Crippled Children. 103 State Street, Chicago.

*†1887. Develin, Edward, M.D.

*1887. Foster, Charles C., M.D. Orthopedic Surgeon to the Cambridge Hospital; Visiting Physician to the Avon Home for Children; Visiting Physician to St. Luke's Home for Children. 5 Riedesel Avenue, Cambridge, Mass.

*1887. Gibney, V. P., M.D. Professor of Orthopedic Surgery in the New York Polyclinic; Surgeon-in-chief to the New York Hospital for Ruptured and Crippled; Orthopedic Surgeon to the Nursery and Child's Hospital, New York. *President*, 1887. *Vice-President*, 1889. 16 Park Avenue, New York.

1889. Gillette, Arthur J., M.D. Visiting Orthopedic Surgeon to University Dispensary; and Orthopedic Surgeon to St. Luke's Hospital, St. Paul. *Second Vice-President*, 1893. 301 Pleasant Avenue, St. Paul, Minnesota.

1892. Goldthwait, Joel E., M.D. Attending Physician to St. Luke's Convalescent Home; Visiting Surgeon to the Good Samaritan Hospital, Boston. 719 Boylston Street, Boston.

1892. Griffith, J. D., M.D. Professor of Surgery, Kansas City Medical College; Surgeon to All Saints, St. Joseph's, Children's, and German Hospitals; President of the State Board of Health; Surgeon-General National Guard S. Mo. S. W. corner Ninth and Grand Avenue, Kansas City, Missouri.

1892. Hoadley, A. E., M.D. Professor of Orthopedic Surgery and Surgical Diseases of Joints, Chicago Polyclinic; Professor of Orthopedic Surgery and Surgical Diseases of Joints and Clinical Surgery, College of Physicians and Surgeons; Attending Orthopedic Surgeon to the Home for Destitute Crippled Children, Chicago. 683 Washington Boulevard, Chicago.

*1887. Hodgen, Harry, M.D. 2604 Locust Street, St. Louis.

1893. Hosmer, A. B., M.D. Orthopedic Surgeon to St. Luke's Hospital; Attending Orthopedic Surgeon to the Home for Destitute Crippled Children. 103 State Street, Chicago, Ill.

1893. Hubbard, LeRoy, W., M.D. Senior Assistant Surgeon, New York Orthopedic Hospital and Dispensary. 161 West Twenty-third Street, New York.

*1887. Judson, A. B., M.D. Orthopedic Surgeon to the Outpatient Department of the New York Hospital. *Vice-President*, 1890. *President*, 1891. *Treasurer*, 1893. 38 East Twenty-fifth Street, New York.

*1887. Ketch, Samuel, M.D. Senior Assistant Surgeon to the New York Orthopedic Hospital; Surgeon to the Randall's Island

Hospital; Clinical Professor of Orthopedic Surgery in the New York Woman's Medical College. *Corresponding Secretary*, 1887 to 1891. *First Vice-President*, 1893. 328 West Twenty-ninth Street, New York.

*1887. Lee, Benjamin, M.D. Secretary of the State Board of Health of Pennsylvania; Professor of Orthopedics in the Philadelphia Polyclinic and College for Graduates in Medicine. *Vice-President*, 1889. *President*, 1892. 1532 Pine Street, Philadelphia.

*1887. Lovett, Robert W., M.D. Surgeon to the Samaritan Hospital; Assistant Out-patient Surgeon to the Children's Hospital; Out-patient Surgeon to the Carney Hospital. *Secretary*, 1889. 379 Boylston Street, Boston.

1893. McCurdy, Stewart LeRoy, M.D. Professor of Orthopedic and Clinical Surgery, Ohio Medical University, Columbus, Ohio; Lecturer on Topographical Anatomy and Landmarks, Western Pennsylvania Medical College, Pittsburg, Pa.; Surgeon to the Protestant Hospital, Columbus, Ohio. Dennison, Ohio.

1889. McKenzie, B. E., M.D. Lecturer on Orthopedic Surgery in the Woman's Medical College; Consulting Orthopedic Surgeon to the Hospital for Sick Children, Toronto. 14 Bloor Street, West Toronto, Canada.

*1887. Moore, James E., M.D. Professor of Orthopedic Surgery in the University of Minnesota; Orthopedic Surgeon to St. Mary's Hospital; Consulting Surgeon to the Northwestern Hospital for Women and Children. 125 Fourth Street, South, Minneapolis, Minn.

1889. Myers, T. Halsted, M.D. Orthopedic Surgeon to St. Luke's Hospital; Assistant Surgeon to the New York Orthopedic Dispensary; Surgeon to the Presbyterian Hospital Dispensary. 24 West Fiftieth Street, New York.

*1887. Packard, George B., M.D. Professor of Orthopedic Surgery in the University of Colorado. 1405 Stout Street, Denver.

*1887. Park, Roswell, M.D. Professor of Surgery in the Medical Department of the University of Buffalo; Surgeon to the Buffalo General Hospital; Consulting Surgeon to the Fitch Accident Hospital and the Buffalo Eye and Ear Infirmary. 510 Delaware Avenue, Buffalo, N. Y.

1890. Phelps, A. M., M.D. Professor of Surgery in the University of Vermont; Professor of Orthopedic Surgery in the University of the City of New York, Medical Department; Professor of Orthopedic Surgery in the Post-Graduate Medical School and Hospital; Visiting Surgeon to the City Hospital, New York; Consulting Surgeon to the Mary Fletcher Hospital, Burlington, Vt.; Surgeon-in-chief to

the Orthopedic Department of the Post-Graduate Hospital, New York. *President*, 1894. 40 W. Thirty-fourth Street, New York.

1893. Plympton, W. O., M.D. Instructor in Orthopedic Surgery, Post-Graduate Medical School and Hospital; Assistant to the Chair of Orthopedic Surgery, University Medical School; Visiting Surgeon to the Post-Graduate Hospital, New York. 40 West Thirty-fourth Street, New York.

*1887. Ridlon, John, M.D. Professor of Orthopedic Surgery in the Northwestern University Medical School; Professor of Orthopedic Surgery in the Post-Graduate Medical School of Chicago; Senior Attending Orthopedic Surgeon to St. Luke's Hospital; Medical Director of the Home for Destitute Crippled Children. *Secretary and Treasurer*, 1891 and 1892. *Secretary*, 1893 and 1894. 103 State Street, Chicago.

*1887. Ryan, George W., M.D. Clinical Lecturer on Orthopedic Surgery in the Medical College of Ohio. *Secretary*, 1890. *Vice-President*, 1891. 114 W. Ninth Street, Cincinnati.

1889. Sayre, Lewis A., M.D. Professor of Orthopedic Surgery in the Bellevue Hospital Medical College; Consulting Surgeon to the Bellevue Hospital, the Charity Hospital, and the Home for Incurables. 285 Fifth Avenue, New York.

*†1887. Sayre, Lewis Hall, M.D.

*1887. Sayre, Reginald H., M.D. Assistant to the Chair of Surgery in Bellevue Hospital Medical College; Orthopedic Surgeon to the Out-door Department of Bellevue Hospital. *Vice-President*, 1892. 285 Fifth Avenue, New York.

*1887. Schapps, John C., M.D. Orthopedic Surgeon to St. Mary's Hospital Dispensary, Brooklyn. 498 Bedford Avenue, Brooklyn.

1889. Scudder, Charles Locke, M.D. Assistant in Surgery in Harvard University; Surgeon to the Out-patient Department of Massachusetts General Hospital. 94 Charles Street, Boston.

*1887. Shaffer, Newton M., M.D. Attending Surgeon-in-charge of the New York Orthopedic Hospital and Dispensary; Consulting Orthopedic Surgeon to St. Luke's Hospital; Consulting Surgeon to the New York Infirmary for Women and Children. *President*, 1888. 28 E. Thirty-eighth Street, New York.

1889. Sherman, Harry M., M.D. Orthopedic Surgeon to the Children's Hospital, and to the Polyclinic, San Francisco. *Vice-President*, 1894. 705 Sutter Street, San Francisco.

*1887. Steele, A. J., M.D. Professor of Orthopedic Surgery and Diseases of the Joints in the St. Louis Post-Graduate School of

Medicine; Surgeon to the Augusta Children's Hospital, St. Louis. *Vice President*, 1890. *President*, 1893. 2825 Washington Avenue, St. Louis.

*1887. Taylor, Henry Ling, M.D. *Vice-President*, 1892. 201 W. Fifty-fourth Street, New York.

1892. Taylor, William J., M.D. Surgeon to St. Agnes's Hospital; Assistant Surgeon to the Orthopedic Hospital and Infirmary for Nervous Diseases. 121 S. Eighteenth Street, Philadelphia.

1892. Thorndike, Augustus, M.D. Surgeon to the Good Samaritan Hospital, and to the Boston Dispensary. 101 Beacon Street, Boston.

1889. Townsend, W. R., M.D. Lecturer on Orthopedic Surgery in the New York Polyclinic; Assistant Surgeon to the Hospital for Ruptured and Crippled, New York; Orthopedic Surgeon to the French Hospital. 28 W. Fifty-ninth Street, New York.

*1887. Vance, Ap Morgan, M.D. Surgeon to the Louisville City Hospital, to Sts. Mary and Elizabeth Hospital, and to the Masonic Widows' and Orphans' Home and Infirmary. *Vice-President*, 1891. 229 W. Chestnut Street, Louisville, Ky.

1889. Weigel, Louis A., M.D. Orthopedic Surgeon to the Outpatient Department of Rochester City Hospital. 43 Mortimer Street, Rochester, N. Y.

1890. Whitman, Royal, M.D. Assistant Surgeon to the Outpatients in the Hospital for Ruptured and Crippled, New York. 126 W. Fifty-ninth Street, New York.

*1887. Willard, De Forest, M.D. Clinical Professor of Orthopedic Surgery in the University of Pennsylvania; Surgeon to the Presbyterian Hospital; Consulting Surgeon to the White Cripples' Home, the Colored Cripples' Home, and the Home for Incurables, Philadelphia; Consulting Surgeon to the New Jersey State School for Feeble-minded Children. *President*, 1890. 1601 Walnut Street, Philadelphia.

1891. Wilson, H. Augustus, M.D. Clinical Professor of Orthopedic Surgery in the Jefferson Medical College; Professor of General and Orthopedic Surgery in the Philadelphia Polyclinic and College for Graduates in Medicine; Orthopedic Surgeon in the Polyclinic Hospital; Clinical Professor of Orthopedic Surgery in the Woman's Medical College of Pennsylvania; Surgeon to St. Mark's Home for Aged and Infirm Women, Philadelphia; Consulting Orthopedic Surgeon to the Kensington Hospital for Women, and to the Philadelphia

Lying-in Charity. *Vice President*, 1894. 1611 Spruce Street, Philadelphia.

1893. Wirt, William E., M.D. Professor of Orthopedic Surgery in the Medical Department University of Wooster, Cleveland, Ohio; Visiting Surgeon to University Hospital; Orthopedic Surgeon to Cleveland Hospital for Women and Children. 122 Euclid Avenue, Cleveland, Ohio.

1890. Young, James K., M.D. Instructor in Orthopedic Surgery in the University of Pennsylvania; Attending Surgeon to the Orthopedic Department of the University Hospital. 222 S. Sixteenth Street, Philadelphia.

HONORARY MEMBERS.

ELECTED

1891. EDMUND ANDREWS, M.D., 65 Randolph Street, Chicago, Illinois.

1889. HENRY G. DAVIS, M.D., 8 Parlin Street, Everett, Mass.

1892. WILLIAM DETMOLD, M.D., 38 E. Ninth Street, New York.

1893. O. LANNELONGUE. Professeur à la Faculté de Médecine de Paris (Chaire de Chirurgie); Membre de l'Académie de Médecine; Chirurgien de l'Hôpital Trousseau à Paris, et Député au Parlement Français, et Président de l'Association Générale de Médecine de France. 3 Rue François I., Paris.

1889. W. J. LITTLE, M.D., F.R.C.P. Lond., M.R.C.S. Eng., Ryarsh, West Malling, Kent, England.

1890. WILLIAM MACEWEN, M.D., LL.D., Professor of Clinical Surgery, and Surgeon to the Glasgow Royal Infirmary; Surgeon to the Royal Hospital for Sick Children. 3 Woodside Crescent, Glasgow, Scotland.

1893. LEOPOLD OLLIER. Professeur du Clinique Chirurgicale à la Faculté de Médecine de Lyon; Correspondant de l'Institut de France. 3 Quai de la Charité, Lyons.

*1889. DAVID PRINCE, M.D.

1891. C. FAYETTE TAYLOR, M.D., 201 W. Fifty-fourth Street, New York.

* Deceased.

CORRESPONDING MEMBERS.

ELECTED

1890. WILLIAM ADAMS, F.R.C.S., Senior Surgeon to the Great Northern Central Hospital, and to the National Hospital for the Paralytic and Epileptic; Consulting Surgeon to the National Orthopedic Hospital. 5 Henrietta Street, Cavendish Square, W., London, England.

1889. Dr. F. BEELY, Steglitzer Strasse 10, Berlin, Germany.

1892. M. BILHAUT, M.D., 5 Avenue de l'Opéra, Paris, France.

1893. Dr. JULIUS DOLLINGER, ausserordentlich-öffentlicher Professor für Orthopädie an den königl. ungarischen Universität in Buda-Pest, Operateur und dirigirenden Oberarzt der chir. Abtheilung im Spitalls der Barmherzigen Brüder in Buda-Pest; Mitglied des Landessanitätsrathes; Mitglied des Landesunterrichtsrathes; Mitglied mehrerer wissenschaftlichen Gesellschaften und Vereine. Buda-Pest (Ungarn), Rerepescher Str. 52.

1892. NICHOLAS GRATTAN, F.R.C.S. Edin., Senior Surgeon, County and City of Cork Hospital for Women and Children. 24 South Mall, Cork, Ireland.

1890. Dr. A. HOFFA, Privatdocent der Chirurgie an der Universität Würzburg. Sieboldstrasse 10, Würzburg.

1890. ROBERT JONES, F.R.C.S. Edin., Honorary Surgeon, Royal Southern Hospital. 11 Nelson Street, Great George Square, Liverpool, England.

1890. Dr. E. KERMISSON, Professeur agrégé de la Faculté de Médecine; Chirurgien de l'Hôpital des Enfants Assisté. 27 Quai d'Orsay, Paris, France.

1890. Dr. SIGFRED LEVY, Superintending Surgeon of the Society for the Relief of Crippled and Mutilated Children, Copenhagen. 135 Gothersgade, Copenhagen, Denmark.

1892. ERNEST MUIRHEAD LITTLE, F.R.C.S. Eng., Surgeon to the National Orthopedic Hospital. 40 Seymour Street, Portman Square, London, England.

ELECTED

1889. PROF. DR. ADOLF LORENZ, Maximilian-platz 7, Vienna, Austria.

1889. HOWARD MARSH, F.R.C.S. ENG., Senior Assistant Surgeon and Lecturer on Surgery, St. Bartholomew's Hospital; Consulting Surgeon, Hospital for Sick Children, and Alexandra Hospital for Hip Disease. 30 Bruton Street, W., London, England.

1890. EDMUND OWEN, M.B., F.R.C.S., Surgeon to, and Joint Lecturer on Surgery at, St. Mary's Hospital; Senior Surgeon to the Hospital for Sick Children, Great Ormond Street. 64 Great Cumberland Place, W., London, England.

1892. PIETRO PANZERI, M.D., Direttore di Istituto dei Rachitici, Milano. Via S. Calimero 31, Milano, Italy.

1892. ROBERT WILLIAM PARKER, M.R.C.S. ENG., Senior Surgeon, East London Hospital for Children; Surgeon, German Hospital, Dalston. 13 Welbeck Street, W., London, England.

1890. PAUL REDARD, M.D., Lauréat de l'Institut; Ancien Chef de Clinique Chirurgicale de la Faculté de Médecine de Paris; Chirurgien du Dispensaire Furtado-Heine. 3 Rue de Turin, Paris, France.

1888. BERNARD ROTH, F.R.C.S. ENG. 29 Queen Anne Street, Cavendish Square, W., London, England.

1890. NOBLE SMITH, F.R.C.S. EDIN., L.R.C.P. LOND., M.R.C.S. ENG., L.M.; Surgeon to All Saints' Children's Hospital; Orthopedic Surgeon to British Home for Incurables. 24 Queen Anne Street, Cavendish Square, W., London, England.

*1890. HUGH OWEN THOMAS, M.R.C.S. ENG.

1890. W. J. WALSHAM, F.R.C.S. ENG., M.B. and C.M. ABERDEEN; Assistant Surgeon and Surgeon in Charge of Orthopedic Department, and Lecturer on Anatomy, St. Bartholomew's Hospital; Surgeon, Metropolitan Hospital; Consulting Surgeon to Hospital for Hip Diseases, Sevenoaks, and to the Burnley Cottage Hospital. 27 Weymouth Street, Portland Place, W., London, England.

1890. GEORGE ARTHUR WRIGHT, B.A., M.B. OXON, F.R.C.S.; Senior Assistant Surgeon, Royal Infirmary, Manchester; Surgeon to Children's Hospital, Pendlebury and Manchester. 8A St. John Street, Manchester, England.

* Deceased.

MINUTES

OF THE

SEVENTH ANNUAL MEETING

OF THE

AMERICAN ORTHOPEDIC ASSOCIATION.

Held at St. Louis, September 19, 20, *and* 21, 1893.

FIRST DAY—*Morning Session.*

The Association met in the Hall of the College of Pharmacy in St. Louis, and was called to order by the President, Dr. A. J. Steele, at 9 o'clock.

In the absence of the Secretary, Dr. George W. Ryan was appointed Secretary *pro tem.*

On motion of Dr. Gillette, it was voted to postpone the President's Address until the evening session.

A paper on "Congenital Deformities," by Dr. DeForest Willard, was read by title.

A paper entitled "A Case of Deformity of the Lower Limbs, with Spina Bifida," by Dr. William J. Taylor, was read by title.

A paper on "Some of the Uses of Continued Extension," by Dr. Henry G. Davis, was read by the Secretary.

Dr. Wilkes, of Bowling Green, Mo., and Dr. Borck, of St. Louis, were made guests of the Association.

A paper on "Historical Notes of the Use of Traction in Diseases of the Joints," by Dr. A. B. Judson, was read by title.

A paper on "Cases of Osteo-sarcoma Simulating Tubercular Hip Disease," by Dr. A. J. Gillette, was read.

On motion of Dr. Hoadley, it was voted to postpone the Executive Session until evening.

A paper on "A Double-lever Stretching Apparatus for Club-foot," by Dr. T. Halsted Myers, was read by the President.

The session then adjourned.

Evening Session.

The meeting was called to order by the President at 8 o'clock, and the Association went into Executive Session.

The Committee on Membership reported for election the following candidates:

For active membership—Dr. W. E. Wirt, of Cleveland, Ohio; Dr. L. S. McCurdy, of Dennison, Ohio; Dr. A. L. Blesh, of Lost Springs, Kansas; Dr. O. W. Plympton, of New York; Dr. A. B. Hosmer, of Chicago; Dr. F. S. Coolidge, of Chicago; and Dr. L. W. Hubbard, of New York.

For honorary membership—Dr. Lannelongue, of Paris, France; Dr. Ollier, of Lyons, France.

For corresponding membership—Dr. J. Dollinger, of Buda-Pesth, Austro-Hungary.

Proceeding with the election, Dr. Wirt and Dr. McCurdy were unanimously elected. Dr. Plympton, Dr. Coolidge, Dr. Hosmer, and Dr. Hubbard were unanimously elected.

The President then appointed Dr. Willard and Dr. Blanchard a committee to audit the accounts of the Treasurer.

The Executive Session then adjourned, and the scientific work was taken up.

A paper entitled "The Treatment of Lateral Curvature by Pressure-correction and Gymnastics, with Lantern-slide Illustrations," by Dr. L. A. Weigel, was read and a large number of illustrations thrown on a screen.

Dr. O. A. Wall, of St. Louis, by invitation, then lectured on Correct Form and Expression, and incidentally One Cause of Lateral Curvature, the lecture being illustrated by a large number of lantern slides.

It was voted to postpone the discussion of Dr. Weigel's paper until the next session.

The President's Address, entitled "The Embodiment of an Idea," was then read by Dr. Steele.

The session then adjourned.

Second Day—*Morning Session.*

The meeting was called to order by the President.

A paper on "The Mental Condition of the Patient as an Element in the Treatment of Obstinate Surgical Affections," by Dr. Ansel G. Cook, was read.

A paper on "A Case of Fragilitas Ossium, Exhibiting over One Hundred Broken Bones," was read by Dr. Wallace Blanchard.

A paper entitled "Exhibition of New Traction Mechanism for Hip Splints, with Remarks," by Dr. L. A. Weigel, was read.

A paper on "The Question of Excision of the Hip-joint for Tubercular Disease, and the Results of the Operation," by Dr. Harry M. Sherman, was read.

A paper on "The Etiology of the Deformities of Knee-joint Disease," by Dr. A. M. Phelps, was read.

The session then adjourned.

Afternoon Session.

The meeting was called to order by the President at 2.30 o'clock.

A paper on "The History of the Treatment of Tumor Albus of the Knee," by Dr. J. D. Griffith, was read.

A paper entitled "Exhibition of the Ideal Knee Splint, with Remarks," by Dr. John Ridlon, was read.

A paper entitled "Exhibition of a New Knee Splint, its Action and Advantages," by Dr. A. E. Hoadley, was read.

A paper on "A Simple and Effective Knee Splint," by Dr. Wallace Blanchard, was read.

A paper on "The Operative Treatment of Knee-joint Disease," by Dr. DeForest Willard, was read.

The session then adjourned.

Third Day—*Morning Session.*

The meeting was called to order by the President at 9 o'clock.

A paper on "Bone Operations for the Correction of Club-foot, based upon an Analysis of 435 Operations by 108 Operators," by Dr. H. Augustus Wilson, was read.

A paper entitled "The Cause of Flat-foot," by Dr. Newton M. Shaffer, was read.

A paper entitled "Exhibition of the Paper Jacket, also of an Apparatus for Recording Rotation in Lateral Curvature," by Dr. L. A. Weigel, was read. Metal breast-protectors for use in working plaster jackets were also shown.

Dr. Phelps exhibited an Aluminum Corset.

The session then adjourned and went into Executive Session.

Executive Session.

The minutes of the last Executive Session were read and approved.

The Auditing Committee reported that they had examined the accounts and vouchers of the Treasurer and found them correct.

On motion of Dr. Ryan, it was voted that the report be accepted and the Committee discharged.

On motion of Dr. Shaffer, it was voted that the Treasurer be instructed to collect dues of the Corresponding Members.

Dr. Shaffer, as a Committee on the paper of Dr. H. G. Davis, reported, and on his motion it was voted to accept the paper and print it in the TRANSACTIONS.

On motion of Dr. Weigel, it was voted to proceed with the election of candidates for Honorary and Corresponding Membership. Dr. Lannelongue, of Paris, France, and Dr. Ollier, of Lyons, France, were elected Honorary Members.

Dr. Julius Dollinger, of Buda-Pesth, Austro-Hungary, was elected Corresponding Member.

On motion of Dr. Wilson, it was voted that all requests for gift-copies of the volumes of our TRANSACTIONS be referred to the Committee on Publication with power to act.

On motion of Dr. Hoadley, it was voted that the President be instructed to issue Delegates' Credentials to such members as may go to the Eleventh International Medical Congress, at Rome.

On motion of Dr. Shaffer, it was voted that a vote of thanks be extended to the Health Commissioner of St. Louis for his invitation to visit the Institution of his Department.

On motion of Dr. Weigel, it was voted to tender a vote of thanks

to Dr. Paul Redard for the copy of his *Treatise on Orthopedic Surgery.*

On motion of Dr. Ridlon, it was voted that all papers presented at this meeting by the members and remaining unread at the final adjournment be read by title and referred to the Committee on Publication for action.

On motion by Dr. Shaffer, it was voted that a catalogue of the books in the library of the Association be printed in the TRANSACTIONS, and that each member be permitted to borrow from the library for the period of one month.

On motion by Dr. Weigel, it was voted that a Committee consisting of the President and Secretary be, and hereby is, appointed to take such action as may seem best looking toward placing the books and pamphlets in the library of the Association in permanent and available form.

On motion of Dr. Wilson, it was voted that all applications for membership be referred to the Committee on Membership.

Dr. Shaffer, seconded by Dr. Ryan, presented the following amendment to the Constitution:

"*Resolved*, That the active membership be limited to sixty."

On motion of Dr. Ridlon, it was voted that the papers presented by the candidates be submitted to the Committee on Publication for publication in the TRANSACTIONS.

The election of officers for the coming year was then proceeded with. The following gentlemen were elected:

President—Dr. A. M. Phelps, of New York.

First Vice-President—Dr. H. Augustus Wilson, of Philadelphia.

Second Vice-President—Dr. Harry M. Sherman, of San Francisco.

Secretary—Dr. John Ridlon, of Chicago.

Treasurer—Dr. E. G. Brackett, of Boston.

Member of the Committee on Arrangements for the Congress of American Physicians and Surgeons—Dr. DeForest Willard.

The following candidates were nominated:

For active membership—Dr. Goodwin, of New York, by Drs. Phelps and Griffith; Dr. Kerr, of Washington, D. C., by Drs. Phelps and Bradford; Dr. C. J. Mooney, of New York, by Drs. Phelps and Griffith; Dr. LeMoyne Wills, of Los Angeles, Cal., by

Drs. Sherman and Ridlon; Dr. Thomas W. Huntington, of Sacramento, Cal., by Drs. Sherman and Phelps; Dr. Emory Lanphear, of Kansas City, Mo., by Drs. Ridlon and Hoadley.

For corresponding membership—Bernard E. Brodhurst, of London, by Drs. Ridlon and Weigel.

It was voted that a vote of thanks be extended to the St. Louis College of Pharmacy for the use of the hall.

It was voted that a vote of thanks be extended to Dr. O. A. Wall for his beautiful demonstrations.

The Association then went into Scientific Session.

A paper on "The Value of Traction in Hip-disease as investigated by Experiment," by Dr. E. H. Bradford, was read.

A paper on "The Manual Treatment of Bow-legs and Knock-knee," by Dr. Samuel Ketch, was read.

Dr. Schapps' cot was presented by the President.

The following members were present:

Drs. Bernard Bartow, Wallace Blanchard, E. H. Bradford, Ansel G. Cook, Frederic S. Coolidge, Charles C. Foster, Arthur J. Gillette, J. D. Griffith, A. E. Hoadley, H. Hodgen, Samuel Ketch, A. M. Phelps, John Ridlon, George W. Ryan, Newton M. Shaffer, Harry M. Sherman, A. J. Steele, L. A. Weigel, DeForest Willard, H. Augustus Wilson.

CONSTITUTION AND BY-LAWS.

CONSTITUTION.

ARTICLE I.—NAME.

THIS Society shall be called the "AMERICAN ORTHOPEDIC ASSOCIATION."

ARTICLE II.—OBJECTS.

The purpose of this Association shall be the advancement of Orthopedic science and art.

ARTICLE III.—MEMBERSHIP.

SECTION 1. The members shall be graduates of regular medical schools, shall be in good professional standing, and shall be especially interested in Orthopedic Surgery.

SEC. 2. There shall be three classes of members, viz.: Active, Corresponding, and Honorary.

SEC. 3. Candidates for membership shall have been engaged in the practice of medicine for at least five years, and shall have given evidence of satisfactory scientific attainments.

ARTICLE IV.—OFFICERS.

The officers shall consist of a President, a First Vice-President, a Second Vice-President, a Secretary, and a Treasurer, all to be elected annually at the last executive session of a regular meeting.

ARTICLE V.—STANDING COMMITTEES.

There shall be a Committee on Membership, consisting of five members, a Committee on Publication, consisting of three members, and an Executive Committee, consisting of the President, the Secretary, and the Treasurer.

ARTICLE VI.—ELECTIONS.

All elections shall be by ballot; for officers a majority shall elect for members a four-fifths majority.

ARTICLE VII.—MEETINGS.

The meetings of the Association shall be Regular and Special.

ARTICLE VIII.—FEES.

Active members shall pay an initiation fee of twenty-five dollars, and annual dues of fifteen dollars. Corresponding members shall pay annual dues of five dollars.

ARTICLE IX.—PUBLISHED PROCEEDINGS.

The business proceedings of the Association shall be published annually. The papers and discussions shall be published annually, unless the Association otherwise directs at the close of the regular meeting.

ARTICLE X.—DISCIPLINE.

A three-fourths vote of all members present at a regular meeting shall be necessary for suspension or expulsion of a member.

ARTICLE XI.—THE CONGRESS.

SECTION 1. This Association shall hold membership in and meet with the Congress of American Physicians and Surgeons.

SEC. 2. It shall, at the regular meeting held at the time of the Congress, elect a member to represent it on the Executive Committee of the Congress for the ensuing three years, and it shall also elect a second member as an alternate.

ARTICLE XII.—QUORUM.

An actual presence of nine active members at any one meeting shall be necessary for the transaction of business.

ARTICLE XIII.—AMENDMENTS.

Alterations to this Constitution may be made at any regular meeting by a four-fifths vote of all members present; provided that notice of the proposed changes, signed by two active members, shall have been given to all the active members at least one month previous to final action.

BY-LAWS.

ARTICLE I.—MEMBERSHIP.

SECTION 1. Nominations for membership shall be made in writing, signed by the proposer and seconder, accompanied by evidence as to the fitness of the candidate for fellowship, and shall be placed in the hands of the Secretary at least twelve months previous to the time of the regular meeting.

SEC. 2. Candidates for active membership shall, through the Secretary, present a paper to the Association.

SEC. 3. Only those of acknowledged preëminence in orthopedic surgery shall be eligible to honorary membership.

SEC. 4. Foreign residents only shall be eligible to corresponding membership.

SEC. 5. All the scientific privileges of the Association shall be accorded to the honorary and corresponding members.

SEC. 6. Membership shall be forfeited when one ceases to take an active interest in the objects of the Association, or is guilty of an unprofessional act or a public misdemeanor. Action in such cases shall be taken according to Article X. of the Constitution.

SEC. 7. An active member absenting himself for three consecutive meetings, or two years in arrears in payment of dues, may be dropped from the rolls.

SEC. 8. All members in attendance at any metting shall register in a book provided for the purpose.

ARTICLE II.—OFFICERS AND STANDING COMMITTEES.

SECTION 1. The duties of officers and standing committees shall commence after the adjournment of the meeting at which they are elected or appointed, and shall continue until their successors are duly installed.

SEC. 2. The President shall preside at all meetings, shall deliver an annual address, shall appoint the Committees on Membership and Publication, shall fill any vacancies that may occur from resignation or otherwise.

SEC. 3. The Vice-Presidents shall act in the absence of the President.

SEC. 4. The Secretary shall give due notice of and keep the minutes of all meetings, shall conduct all correspondence, shall notify candidates of their election to membership, and inform members of their appointment on committees, and shall perform such other duties as are assigned to him by the Association.

SEC. 5. The Treasurer shall collect all money due the Association, be the custodian of the same, and pay it out only on warrant signed by the President and Secretary. At the annual meeting he shall make a report of his receipts and expenditures, which, after being duly audited, shall be filed.

SEC. 6. The Membership Committee shall consider the eligibility of all nominees for membership, and shall report its recommendations to the Association.

SEC. 7. The Executive Committee shall make all necessary arrangements for the meetings of the Association, assign the order for scientific work, and report the same to all members as early as practicable before the time of the annual meeting; it shall further manage such necessary affairs of the Association as are not already assigned to others.

SEC. 8. The Publication Committee shall attend to the preparation, publication, and distribution of the annual proceedings of the Association; and it shall have discretionary power as to matter for publication in questionable cases.

ARTICLE III.—ELECTIONS.

Elections of members shall be held at the first executive session of a regular meeting, and of officers at the last business session.

ARTICLE IV.—MEETINGS.

SECTION 1. The regular meetings shall be held annually during the third week in September of each year, or at such other time and at such place as the Association may elect. If no action should be taken in the matter, the Executive Committee shall decide.

SEC. 2. Special meetings may be called by the Executive Committee or by the President at the written request of ten active members.

SEC. 3. Every third year the Association shall convene as a part of the Congress of American Physicians and Surgeons.

ARTICLE V.—DUES.

The yearly dues shall be paid to the Treasurer at the time of registration.

ARTICLE VI.—PUBLISHED PROCEEDINGS.

SECTION 1. The Transactions shall be printed as soon after the adjournment of the regular meeting as possible, and distributed to the members, one copy to each except to those in arrears on Association dues.

SEC. 2. Additional copies of the Transactions shall be furnished to members at cost, and to the public at a price to be determined by the Publication Committee.

SEC. 3. Authors desiring reprints of their papers will notify the Publication Committee, who shall already have established rates for reprints with the publishers.

SEC. 4. Papers not in the hands of the Secretary within four weeks after adjournment of the meeting shall be omitted from the Transactions on the unanimous vote of the Publication Committee.

ARTICLE VII.—PAPERS AND DISCUSSIONS.

SECTION 1. Papers read before the Association shall be limited to twenty minutes, unless the time be extended by vote. Discussions shall be limited to five-minute speeches. No member shall speak a second time on the same subject if others desire the floor. The author of the paper shall be privileged to close the debate.

Sec. 2. No papers shall be read that have been previously published. Members publishing their papers after they have been presented to the Association shall designate them, "Read before the American Orthopedic Association." Authors desiring their papers illustrated shall furnish the necessary woodcuts.

Sec. 3. Proofs sent to authors should be returned within a fortnight, otherwise the matter will go to press without the author's correction. Marked changes from copy, known as "time work," shall be paid for by the author.

Sec. 4. Transcripts of the discussion shall be furnished the participants for correction, but not for re-writing.

ARTICLE VIII.—EXECUTIVE.

Section 1. Two executive sessions shall be held during each regular annual meeting, to wit: at noon of the first day, and at noon of the last day. The order of business shall be:

1. Reading of unapproved minutes and records.
2. Reports of officers and committees and action thereon.
3. Unfinished business.
4. Election.
5. New business.

The last act before adjournment of the last session shall be the reading of unapproved minutes and action thereon. Urgent business may be transacted at any session by unanimous consent.

Sec. 2. The proceedings of the Association shall be in accordance with parliamentary usage.

ARTICLE IX.—AMENDMENTS.

Proposed Amendments to the By-laws shall be submitted in writing and signed by two active members. Previous notice of the proposed changes shall be given. A three-fourths affirmative vote of all members present at a regular meeting shall be necessary to ratification.

THE PRESIDENT'S ADDRESS.

THE EMBODIMENT OF AN IDEA.

By A. J. STEELE, M.D.,
ST. LOUIS.

"Orthopedics has to do with bone distortion and joint function: its object is to restore normal form and useful action."

Nothing in the nature of man is more wonderful or more admirable than his ability to express in material form the thought of his brain; or that he can shape the actions of men, and even order events in conformity to his preconceived ideas. That which was a seeming phantasy may become through his energy a living verity. He may not create, but he can fashion and form anew until he seems almost to re-create.

This thought finds illustration in each individual of us as orthopedic specialists, in our organization as an Orthopedic Society, and in our department as a division of general surgery. Before proceeding to develop these truths, permit me to borrow an illustration—which, although not in the line of our profession, yet demonstrates my thought—from a work quite familiar to us citizens of St. Louis, and of which we are reasonably proud.

Those of you who entered our city from the east, crossed the Mississippi river on a bridge, marvellous alike in its conception and in its construction. A local historian says in regard to it, that "by the middle of the year 1868 the drawings and all the details of the bridge had been gone through with, and the mighty structure was complete in the mind of the chief engineer." A few years ago there existed the idea only; to-day witnesses the substantial embodiment of it.

The foundations of the abutments and piers rest on solid rock from 55 to 135 feet below high-water mark—the deepest sub-aqueous

structures ever built. The sinking of these piers was a great engineering feat, full of interest. The masonry of each pier was built on the roof of an air-right caisson made of thick iron plates riveted together, 80 feet long, 60 feet wide, and 9 feet deep; the bottom was open, but water and sand were kept out by the force of compressed air from powerful air-pumps. So, as the stonework was laid on top, workmen underneath fed the sand-pumps, and the huge pile slowly sank 50, 100, 135 feet until bed-rock was reached. The men in the caissons were subjected to great air-pressure, the intensity of which reached a maximum of 65 pounds per square inch, 50 pounds above the normal, or more than four atmospheres. The physiological effects of long exposure to this pressure and of sudden release from it, were at times very severe. Over one hundred men were attacked with cramps and chills, and thirteen died as a result. I well remember the time, for we had in the general hospitals many patients suffering from this cause. They came to be known as "bridge cases," and attracted professional attention and great scientific interest, giving rise to warm discussions in societies and journals.

Thus at such great sacrifice, and with not a few hindrances, the foundations were finally laid, marvels of solidity and strength. But this was only a part. The plan of the superstructure of the great bridge was as bold as that of the foundations, and even more original. And yet, with confidence in the resistant strength of chrome steel, the artisans were put to work on arches longer and comparatively lighter than any ever before attempted. In due time the matured plans became fixed facts, and the mighty structure was reared—a lasting monument to the engineering skill of the age, consisting, as you now see it, of three magnificent steel arches supporting two roadways, the lower for double railway tracks, the upper a broad causeway for highway traffic. The central span is an arch of 520 feet, the longest in the world, and of great strength. As you observe the slender arch, formed of light steel tubes in twelve-feet sections and only eighteen inches in diameter, you marvel that in the strength of those graceful lines alone the passing trains are safely held above the "Father of Waters" seething in rapid current one hundred feet below.

The erection of the arches was effected by a novel method.

The tubes, or ribs, were built out from the piers over the water until from the two sides the half-arches met in the centre and the span was completed. I recall the odd appearance of a central pier with these semi-arches extending out on either side without any under-support, like great wings, as though some monster had arisen from the deep and was about to take its flight to other realms. The closing of the arches was a critical moment. Would the two semi-arches, started five hundred feet apart, exactly meet? On one occasion a rise in the temperature so interfered with the engineer's calculations that thousands of pounds of ice had to be used to contract the metal sufficiently to allow the crown of the arch to be closed.

As to the sustaining capacity of the bridge, it is estimated that if the upper highway, 75 feet wide and nearly 2000 feet long, was crowded with men standing closely, and if the two tracks of the lower railway were occupied by as many engines as could be placed in line, yet with this enormous weight, less than one-sixth of the ultimate sustaining strength of the bridge (estimated at 29,000 tons) would be reached.

The approaches to the bridge also are exceptional examples of engineering skill. On the east side a high trestle-work, supported on steel columns for a distance of half a mile, affords easy access to the bridge-way. On the west side a double-tracked subterranean passage-way, a mile long, pierces the city under its busy thoroughfares, affording a safe transit for trains without interfering with street traffic.

The expense of the whole work, $10,000,000, was great, yet it will stand for ages an enduring monument of the skill of its engineer, James B. Eads, and a marvellous illustration of our subject—that matured plans may become fixed facts; that the thought of the mind may find expression through the work of the hands.

In our daily practice, as new problems arise, or as we seek new solutions for old ones, we first plan the treatment, and then put it in practice, the thought finding embodiment to the relief of our patient. Not a club-foot shoe, not a spinal brace, not a knee splint, as we know them to-day in their efficiency, but what once existed in thought only. Some years ago, possibly thirty-five, two surgeons living 3000 miles apart, entertaining ideas positive enough but

diametrically in opposition as to the correct treatment of coxitis, devised splints, each according to his own idea, and gave them to the profession to be extensively used. So to-day we have the modified Davis appliance with its extension and motion on the one hand, and the Thomas splint with its fixation and immobility on the other, each the embodiment of the idea of its inventor. Which is correct? The future will determine. If one is wrong, what great harm has been done! How important, then, that the precedent idea should always be based on correct pathological knowledge, upon the true indications, and upon correct mechanical principles, and withal be practical; then the embodied splint will endure the test of experience. Think of the thousands of orthopedic appliances devised, constructed, tried, and relegated to the store-room. So of many operative procedures that have been suggested; it is an open question whether it is wise to perform them. Take so simple a case as that of club-foot: should the plantar tissues be divided before the tendo Achillis, or should in all cases the heel tendon be cut first? Thus the mere mechanician or the mere operator does not make an orthopedic surgeon. The foundation for such a one should be an educated, disciplined mind, with broad study and earnest application. And once admitted to its portals, earnest thought, study of our appliances, operations, and methods are necessary—certainly before giving them out as good things and new.

Recently, while wandering through the wondrous sights of the White City, amazed and yet rejoicing at the marvellous progress man had made in the various departments of art and science—in the beautiful and in the useful—I was prompted to ask: What had I contributed to make up the great fair by my daily work? What place had orthopedics in this unparalleled display of the world's wonders? None of the exhibits are ours. And yet while the work we do is not for display, still it is important, as much so as any of the handicrafts claiming attention from a sight-seeing public, for our mission is to save *life*, the most precious boon of a benevolent Creator; to preserve the human form, image of that same Creator, and to restore it when marred, and thus incidentally to change a misanthropic disposition to cheerfulness, a helpless body to usefulness.

I have a picture called the "Iron Worker," showing the Temple

completed, and Solomon inviting the artisan builders to elect the most important one of their number to the place of honor at the right of the King. On unveiling the throne the seat was found already occupied by a brawny blacksmith. The indignant people clamored, and the guards rushed in to cut him down, but Solomon stayed them until the usurper should speak in his own defence. "Thou hast, O King! invited all craftsmen but me, but without the tools I fashioned how could these builders have raised the temple?" "True," decided Solomon, "the seat is his by right."

Life, the individual existence and condition, which it is our mission to conserve, precedes works of hands or fruit of brains, and is assuredly entitled to the seat of honor, and when rendered useless by maiming of the body, 'tis ours to correct: what were otherwise a miserable, dependent existence we are able to make both comely and useful.

Our subject finds illustration in our daily work as orthopedic surgeons. Given a deformity, having recognized the indications for treatment, we plan an apparatus, or outline a method for relief, which through the skill of the mechanician, or by the labor of an educated hand, finds embodiment and brings relief to our patient. If it is new and practical we give it to our fellows and the world is benefited by our ideas and by our experience. And it is just this that brings us together to-day, from far and near, that we may exchange experiences and tell which of our embodied ideas have proved worthy of repetition.

While the bridge was building, a hurricane swept over this section of the country; so great was the violence of the wind that cars were carried many feet away, a locomotive was lifted to the top of a fifteen-foot embankment, and great injury was done to the engineering works of the bridge, thus delaying its completion. This proved a suggestive reminder to the engineer that the structure should be made safe from storms however violent, and so a double series of cross bracings were built into the bridge, insuring its future safety against tornadoes. In like manner with us in the treatment of our cases, complications often arise necessitating modifications in our appliances or methods, until possibly improvement follows improvement and perfection is reached. No, I should not say perfection, for there will be work for the inventive genius of the coming orthopedist for many a year.

Again, the history of our Society affords a forcible illustration of our subject. Ten years ago I visited in a distant city one who, like myself, was interested in the correction of deformities, and we considered the possibility and probability of organizing a National Orthopedic Association. It seemed at the time a chimerical dream we were indulging in; and yet the plans were matured, the scheme was heartily indorsed by those approached, and the necessary steps taken, and to-day by your presence we witness the full embodiment of our ideas. Six years have passed since this organization was perfected—six, aye seven years of uninterrupted annual meetings with increasing membership, and with general recognition at home and abroad. Surely our hopes are being realized, not in their completeness, but we are on a firm footing and the future is assured. Already our publications form a valuable storehouse of orthopedic lore, commended and always eagerly anticipated by our brethren on the other side. That they will continue to increase in value and interest is indicated by the number and variety of papers offered for your consideration at this meeting.

It has occurred to me that our annual volume could be made still more valuable should it contain not only our own choicest thoughts, the avenue through which we give our personal experiences, but that it should also contain a reflection of what the whole orthopedic world has done during the year. The progress of orthopedics might be epitomized by a committee of three, one member to take the French and Italian publications, one the German, and one the English-speaking countries. It is true that several of the leading journals publish abstracts of progress, which, however, are readily accessible to but few of our members, whereas if carefully preserved in our own volume all would be benefited.

It was no longer ago than last year that we adopted a new constitution and by-laws, under which we are now working. Further experience may determine the need for elaboration or change in some particulars. Already one occurs to me, namely: Article I., Section 2, should be amended. It reads: "A candidate for active membership shall, through the Secretary, present a paper to the Association." I would add: "two months previous to the meeting at which his election is to take place; the paper becoming a part of the candidate's credentials, and may, if he is elected, be read in general session, and

published in the annual TRANSACTIONS." We ought also to determine to what libraries and journals our TRANSACTIONS should be sent. Applications frequently come, but it is a question whether in all cases they should be granted. A standing rule would assist the Secretary in this matter.

It is a commendable feature of our membership that, with scarcely an exception, we are engaged in public work, hospital, dispensary, or college service. The mass of our cases come from the lower walks of life. So, while we are second to none in the amount of our charity, we also have opportunity as teachers to illustrate the importance of our department, and to correctly interpret the principles and practice of orthopedic surgery. It is not long since the profession innocently asked the meaning of the word, but already even the people are learning to understand it, and without waiting for the family physician to recommend, come voluntarily to the orthopedist with their deformed and crippled children. I cannot too strongly emphasize the benefit that accrues to the teacher in the familiarity and mastery he acquires of his subject. It is a spur to study, to gaining a clear and definite understanding of his department. As a practitioner one's field may be limited, but as a teacher the whole subject is gone over. I would urge our younger members to seek, create, and accept such positions, even though humble the place. And to the student our department can be made exceedingly interesting, for there is so much of object-teaching about it. The thought constantly finds illustration. We have bony specimens of deformity and disease, casts, mechanical appliances, and the patients themselves. In our clinical work the affections are such that they can be seen at a distance by a whole class at once—an advantage we enjoy over the eye, ear, throat, and gynecological clinicians. And shall I omit the ever-attractive operative procedures? No, for it is ours not only to early diagnosticate, but also therapeutically to do whatever is necessary to prevent the deformity or to remedy it, whether it shall be by the application of a brace or the employment of the knife.

In this connection arises the question: What shall we teach? Answer: The prevention and cure of deformities, whether of bone distortion or of joint function. In most cases apparatus is required, the construction and adaptation of which is our especial field; but

operative procedures of whatever kind are ours also to do, as our cases may require. If I am permitted to perform a tenotomy, why not also cut, tap, or inject an abscess; open, scrape, or exsect a joint? The American orthopedist very early included in his practice chronic joint affections, especially those of scrofulous origin. But why limit ourselves to tubercular joints? Joints already deformed from whatever cause are referred to us, but why not take them during the active stage of their disease, properly treat and happily prevent deformity and loss of function? No; whatever the cause of the joint trouble—specific, neuropathic, traumatic, constitutional—all cases should be included in our department. When I first commenced teaching orthopedics in this city, the subject of articular affections was not by our faculty considered to be necessarily included; so, to protect myself and prevent misunderstanding, I had my title to read, "Orthopedic Surgery and Joint Diseases." I observe that one of our Chicago members is doing the same. Let us everywhere insist upon this, and educate the profession and people up to this idea. Whatever Barwell or Marsh include in their pages may be ours, and the sooner we disabuse the public of the prevailing idea that we are simply splint doctors, the better.

I must advise against the young graduate posing at once as a specialist. The longer he is in general practice, the better will he be in a special field. Five or ten years will give him none too long an experience in general work. He may have a specialty, but not limit his practice unless he has a special aptitude, or unless unusual advantages for observation and study have favored him. On a former occasion I suggested that one in our department should possess very much mechanical ability. The knowledge having been acquired, the individual is then ready for his outfit—the *armamentarium orthopædicum*—consisting of the various materials used and the many instruments necessarily employed.

People not only marvel at the amount of charity work we do, but also at our unselfishness in giving our inventions and experience to others. They say, "Why not patent the machine and make money thereby?"—not knowing that it is contrary to the spirit of our calling. No; we give to the world whatever we have that is new and good. We even vie with each other in the celerity with which we

shall tell what we know, jealous lest some other one shall, on a given subject, get into print first. Liberal in our views, charitable in our acts, and benevolent to all—this is our animating spirit.

I am prompted to this thought by having recently noticed that Dr. Hammond had brought suit against a drug-house for manufacturing cerebrine, testine, cardine, etc., on which he claimed proprietorship of some sort; and also by learning incidentally that a prominent orthopedist had patented his invention—a woven-wire corset. By such act the latter gentleman placed himself outside the pale of our recognition. You and I would resort to many an expedient before paying a royalty on a wire splint.

In another way, and in one rarely suggested, does the beneficent work we do find important results. No one can tell how radically changed have been dispositions and temperaments, otherwise doomed to moroseness and misanthropy, by the correction of a congenital or acquired deformity. Had the infant Byron or the child Pope been born in our day, the club-foot of the one would have been corrected, and the boss of the other prevented, and mighty genius, which gave itself to hated satire and immorality, would have sung ennobling verse and Virtue's sweet refrain. We full well know how sensitive are the deformed, how shrinking and how rebellious. A lad of fifteen recently told his mother in my presence, that unless she insisted on my straightening his bowed legs he would jump into the river. Another with Pott's disease, a marked misanthrope, voluntarily lay on a board for weeks and piled ponderous books on his chest to prevent any increase in the deformity. Sufficient note is not taken of the good we do through correcting physical deformities in the way of changing sullen dispositions and correcting evil temperaments.

A few words as to hindrances—things that militate against the rapid success of the individual specialist, and of our specialty as a department of surgery. On our own part there may be want of familiarity with the subject, and an inability to do and perform, or one may have an unfortunate mannerism. It is quite a knack to get on well with children—a faculty that one must acquire to be successful. The sympathy and co-operation of both the mother and child should be enlisted, for our cases are not to be won by a *coup de main,* but rather by a long siege. There must be much of the

suaviter in modo. The greater part of our surgery is not brilliant, but requires skill, time, and patience; and such reinforcements as the parent and patient can give are not to be despised.

The quack has from time immemorial found a large field for his nefarious practices in our department; as the "qualified bone-setter" he has thriven in England; as the "natural bone-setter" in this country. There are several in this State; one especially, in a small town in the western part, derives a large income from an easily gulled public. In early days an Indian fighter, he accidentally learned of his wonderful gifts when thrown upon his own resources. Uneducated, and without a knowledge of medicine, he has founded a chartered Osteopathic Medical College, of which he is board of trustees, faculty, and all. That people, even wealthy and educated, can be found to have faith in this pretender and to submit to his severe manipulations is remarkable. The qualified bone-setters of England, whom Mr. Thomas and others tell of, limit their practice to displaced bones or functionally disturbed joints; but here is one who, finding all diseases caused by deformities and dislocated bones, pulls and twists to cure. The peripatetic quack, by insinuating advertisements and promises to cure, secures many cases, much money, and does irremediable harm. The so-called Orthopedic Institutes, dubbed by a former president "surgical chambers of horror," reap a rich harvest from the crippled unfortunates. Many cases have fallen under my observation of their malpractice and robbery. Their illustrated circulars are scattered broadcast, and paid agents furnish addresses. The surgical instrument-maker, with his show of bright and attractive appliances, is ever ready to give advice and apply his splint, though without knowledge of pathology and quite irresponsible of results. And lastly, in our own profession, physicians failing to early recognize the true character of the affections, and general surgeons, jealous of the inroads we are making in their field, loath to give up their deformity cases, essay too often by a brilliant operation to correct, without the time and patience to personally care for the tedious after-treatment.

But the time rapidly approaches when legislation will drive the charlatan to the wall, and when the education of the masses will prompt them to intelligently seek relief for deformities and joint

troubles from those especially qualified by study, experience, and practice.

I will say to our younger members that the correct ideas have not all been had, or that they have all found embodiment. Consult the pages of late orthopedic works, Bradford and Lovett, if you like, or Schreiber, and one is bewildered by the multiplicity of appliances figured for the relief of deformities. Surely the ideal splint for hip disease has not yet been found, otherwise so many would not be pictured from which to select. If one simple plan of treating club-foot was always successful there would not be such a variety of methods suggested. The different appliances and apparatus which have been proposed for the relief of lateral curvature would easily fill my office rooms; and yet, who cures scoliosis? No, our art is young. The great achievements in our department of surgery are yet to be. Much has been accomplished, but greater trophies will yet be won. So the junior may take heart; earnest application along the lines of pathology and applied therapeutics will bring to him success and fame. When you or I meet a crippled child or a deformed adult in the street, a guilty pang shoots through the heart, for we somehow think it ought not so to be. The deformity should have been prevented, the disease should have been cured: that is the goal of our desires and efforts. We would give the sufferer a normal form and useful action. Often are we baffled, but each failure prompts to renewed effort and more careful observation. We dislike to be beaten: it is a warfare we are engaged in; victory must be ours.

The time will surely come when cripples will be rare, such will have been the progress made in our art, and toward which this Association is contributing no small part. A few years back orthopedics was not generally understood or appreciated, but now a score of institutions are teaching it distinct from general surgery; dispensaries and hospitals have their orthopedic departments; societies have orthopedic sections; abroad are journals devoted especially to its interests, and at home regular reports on its progress are to be found. While our Society numbers will never be great, because the proportionate number of cripples is not large, yet we will be in the front rank as a scientific, progressive organization; for that we are enthusiastic workers is evidenced this day by the number and variety

of papers awaiting your consideration—and this, too, in the face of the scientific attractions recently held out at Washington and elsewhere.

It would be interesting to anticipate the day when the tubercle bacillus, a fruitful source of our deformities, shall have been chained, when more correct living shall have arrested rickets, when more rational training of the young shall have prevented spinal deflections; but your time and patience, already greatly tried, I fear, will not now permit us to further dwell upon the theme. We can only say, speed that day! and cherish it as an *ideal*, which, through your continuous studies and labors, shall find *embodiment*.

A CONTRIBUTION TO THE TREATMENT OF WHITE SWELLING OF THE KNEE.

By A. B. JUDSON, M.D.,
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White swelling of the knee belongs to a class of diseases which it is difficult to believe are not constitutional, but which are so modified in their progress and results by the influence of mechanical environment that, beyond the regulation of the diet, the administration of roborants, and the observance of the laws of hygiene, the only treatment necessary is that which is carried on by the use of mechanical appliances. By no treatment, however, can we abruptly arrest the disease and remove the traces which it almost always leaves in the structures which have been affected. It will be a happy day when the advance of our science puts us in possession of the power to cut short this morbid action and to secure ultimate symmetry and normal ability. Until that day we may well give our best attention to methods of placing the affected member and the system in the best position to take advantage of the inevitable rally of the defensive and reconstructive powers of Nature. For restoration to health and more or less complete function is certain to occur, except in most unfortunate exceptional circumstances. Speaking of hip disease, Brodie exclaimed: "Why should the disease be dangerous? The hip is not a vital organ!"[1] And this is not the less true of white swelling of the knee. Furthermore, in the case of children, among whom our patients are found, we have especial reason to expect, amid the countless transformations attending growth and development, an early occurrence of the favorable reaction in which the disintegrating process ceases, and repair of the damaged structures, so far as it may be looked for, sets in.

[1] Clinical Lectures on Surgery (Philadelphia edition), 1846, pp. 279, 280.

As in the treatment of articular osteitis occurring elsewhere, we seek to arrest the functions of the joint, which in the present instance are twofold, motion and weight-bearing. We are early taught that the function of a joint is to give motion to the otherwise rigid skeleton; but it is only later, when we are perplexed with the treatment of diseased joints in the lower extremities, that we are impressed by the observation that one of the important functions of the bones which go to make up the joints of the lower extremity is the duty of supporting the weight of the body, or a large part of it, in standing, and of enduring the violent blows that are inflicted in rapid succession by the weight of the body in locomotion. Therefore, it follows that, as the function of the knee is twofold, our efforts to arrest this function must also be twofold. We must (1) arrest motion or fix the joint, and we must (2) relieve the joint of the duty of bearing weight. I prefer to do these two things in the joint in question by two separate instruments—one of which, the fixative brace, is to be worn constantly, while the other, the protective splint, or ischiatic crutch, is used when the patient is up, and removed during the hours of sleep.

I. And first, of fixation of the knee: it is one of the very simplest problems in mechanical surgery, made so by the presence in the limb of a long bony lever above and one below a joint (ginglymoid) which practically has no motion except in flexion and extension. How widely different from the problem of fixing the hip-joint, which (a ball and socket) has flexion, extension, abduction, adduction, and rotation, and practically no leverage at all above the joint! The fixative brace for the knee is simply a lever, making pressure from before backward at the place of motion, and counter-pressure from behind forward at two points—one remote from the joint, at the upper part of the femur, and the other, also remote from the joint, at the lower part of the tibia. A bar of soft steel of suitable length is applied to the posterior surface of the limb. To it are attached four cross-pieces, each cross-piece being riveted at the middle of its length and curved so as to half encircle the limb. The upper and lower transverse pieces are applied to the limb with the intervention of pads, while the middle pieces do not necessarily touch the surface of the limb at all, but have at each end a buckle in which pieces of webbing are tightened over the limb in front, one piece of webbing

crossing the lower part of the thigh, and the other the upper part of the leg. If the apparatus is applied to a limb with the knee fully extended and the webbing straps tightly buckled, flexion of the knee is prevented, and, as there is practically no lateral motion, this brace is an efficient means of fixing the knee, not immobilizing it, for immobilization, or the equivalent of bony ankylosis, is impossible by apparatus applied with the intervention of the vulnerable skin and the elastic and mobile subcutaneous tissues.

When the knee is fully extended this fixative splint arrests motion, but when used in a case of deformity it is a convenient and efficient means of bringing the flexed knee into extension. At the beginning it is to be applied with the upright bent to simulate the flexion of the knee, or to be a little straighter than the knee, and the straps are to be buckled more or less tightly, according to the tolerance of pressure, until after a few days of intermitting and gradually increasing pressure the flexion of the limb corresponds with the flexion of the splint. With care and judgment the upright of the splint is to be still further straightened and the pressure re-applied by tightening the straps and buckles as before. In an ordinary case, coming under treatment in the acute stage, this manner of correcting the deformity is easy and certain and painless, and we have the added satisfaction, while thus reducing the flexion, of arresting motion in the knee at the same time. It seems paradoxical to say that we at one and the same time prevent motion and effect a change from flexion to complete extension. This calls to mind the peculiar condition of an inflamed joint, a condition in which the muscles in reflex contraction hold the joint motionless, and yet not so rigidly motionless but that it may be moved by a force gentle, continuous, painless, and harmless. In the hip-joint advantage is taken of this peculiar kind of immobilization, which is better called fixation, to correct the bad position of the limb, without mechanical force, by inducing the patient to adopt habitual attitudes and motions, chiefly the habit of walking in natural rhythm, in which a normal position of the limb gives the patient more convenience in locomotion than a deformed position. With the mechanical advantages found in the knee, however, we can change the position of the joint, regardless of the patient's habits and convenience, by directly applying force through the leverage of the fixative splint. In this affection, as in

all others producing deformity and disability, the best ultimate result, as regards deformity, is to be sought incidentally, while our principal efforts are directed to the promotion of recovery by the arrest of function. Fortunately, in white swelling of the knee the means of arresting motion or fixing the joint are identical with those with which the final good position of the limb is secured.

II. In the second place we must relieve the affected joint from bearing weight in standing and walking, a problem very easy of solution by the use of a pair of crutches and a higher sole on the well foot. But axillary crutches, though sometimes necessary, may, in almost all cases occurring in orthopedic practice, be laid aside in favor of the perineal or ischiatic crutch. This in its simplest form consists of a steel upright ending below in a foot-piece shod with leather, and equipped above with a horizontal semi-circular pelvic band, carrying a padded strap for the reception of the os innominatum. The same apparatus is used for the treatment of hip disease in certain stages, except that in white swelling of the knee the rigid knee-piece is discarded. Its use is to prevent motion at the knee, which is harmful in hip disease, because it is inevitably accompanied by motion at the hip. It is useless in the disease now under consideration, because arrest of motion at the knee is secured by the fixative splint already described. The ischiatic crutch is provided with a shoulder-strap, by which the weight of the apparatus is transferred to the opposite shoulder, and with the ordinary knee-strap of webbing and the leather ankle-strap. The upright should be adjustable in length to accommodate the growth of the patient, or, if there are many patients, uprights of different lengths may be kept in readiness. The ischiatic, like any other crutch, is laid aside at night, to be resumed in the morning with a high sole on the well foot.

OPERATIVE TREATMENT OF KNEE-JOINT DISEASE.

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It is hardly necessary to state that the mechanical treatment of knee-joint disease is an essential condition to success both before and after operative measures. This mechanical protection of the joints is to be begun in the very inception of the disease, and is one of the surest preventives of suppuration; in a great majority of cases entirely superseding all necessity for operation. These mechanical measures should include absolute rest, protection and fixation of the joint, with the avoidance of weight-bearing upon the limb by the use of crutches, either axillary, perineal, or ischiatic.

A large number of neglected cases, however, will demand some form of operative relief. The operative treatment of tubercular knee-joint disease may be divided into:

I. Tenotomy with fixation.
II. Removal of serum.
III. Removal of pus accumulations and degenerated tissues inside and outside the joint.
    a. Aspiration,
    b. Incision and drainage,
    c. Erasion,
    d. Excision,
    e. Amputation.
IV. Hypodermatic injections of anti-bacillary substances, as iodoform, chloride of zinc, etc.
V. Removal of late deformity.
    a. Tenotomy,
    b. Forcible extension with tenotomy,
    c. Osteotomy,
    d. Partial or complete excision.
VI. Treatment of posterior displacement.

I. TENOTOMY WITH FIXATION.—In children under ten years of age, in fact under twelve years, it is especially important to preserve the epiphyseal line as long as possible, in order to secure the greatest possible growth of the limb; conservative surgery, therefore, in this class of cases is to be carried to the extreme degree of mechanical treatment, and this should be thoroughly insisted upon. Operative measures, when necessary, should also be conservative in character, advancing from the milder to the more extreme procedures only when imperatively demanded. In the majority of cases, even when marked flexion exists, and when evidences of induration about the joint are positive, it is wise to temporize, improving the position of the limb by tenotomy of the hamstring tendons, and securing absolute immobility by plaster-of-Paris. By these means many cases can be cured, and even though they advance ultimately to suppuration, much time is thereby gained, together with the benefit of growth.

The question of erasion will be studied under another heading, but radical measures in these young cases are especially to be deplored.

II. REMOVAL OF SERUM.—The prevention of synovial effusion consists first in subduing the inflammation by absolute rest in bed, a posterior splint slightly flexed at the knee, ice-bags or the continual dripping of iced water, and by other antiphlogistic remedies. Presuming that absorbents, blisters, and counter-irritants to produce absorption have proven unavailing, the question of tapping the joint should be considered. It is important to do this before suppuration takes place.

Aspiration for serous effusion, if performed thoroughly antiseptically, rarely gives trouble; yet inflammatory conditions and even deaths have followed this operation. An aspirating trocar of medium size may be carried into the anterior part of the joint. Should the fluid be clear, rest and fixation should be continued, and the patient kept recumbent with a pulley extension weight upon the limb. Should reaccumulation take place, the operation may be repeated as long as only serum is drawn. When pus is definitely determined, or when the symptoms point to its formation, other methods should be considered.

In the acute cases, such as are above described, the diagnosis of

formation of pus is not difficult; but in chronic cases, which are slow in progress and probably tuberculous in character, where there is great thickening about the articulation and much induration, it is not always easy to determine whether the deposit is inflammatory or purulent, or whether it is the thickened and gelatinous degeneration which so frequently occurs in tuberculosis.

If the deposit is of the pulpy variety, the area will be doughy and boggy. All the anatomical features of the joint will be destroyed, and the fossæ upon either side of the patella obliterated. Decided flexion will exist. Pain may not be present, and in some cases this destructive process may have advanced so far that the lateral ligaments have undergone pulpy degeneration, and partial dislocation of the tibia may have taken place. When the above symptoms are present there is but little doubt that pulpy degeneration is present and that operative procedures are necessary. The temperature chart and symptomatic conditions will, of course, assist in the diagnosis.

III. Removal of Pus.—(*a*) *Aspiration* is of but little permanent service in the removal of pus accumulations except for diagnostic purposes.

(*b*) *Incision.* Incision into a knee is usually for the purpose of exploration, and the surgeon, previous to etherization, should have obtained the permission of the patient, or his friends, to go forward with whatever operation may be advisable; usually it will be erasion or excision.

Simple incision is of but little service even in cases of purulent synovitis which are acute in character. In tubercular cases, if the more radical operation is refused by the patient, of course incision permits the introduction directly into the walls of the abscess of thoroughly aseptic and anti-bacillary substances, such as iodoform, chloride of zinc, and the withdrawal of pus, which proceedings facilitate the destruction of the bacilli. As a rule, however, these substances can be introduced subcutaneously into the deposit.

Incision and drainage. When an incision has been made and pus found it will, of course, be followed by drainage of the parts. This will be done either with rubber tubes or with gauze packing, after syringing with peroxide of hydrogen, bichloride, or iodoform oil. Usually the wound, if packed for forty-eight hours and then

closed by sutures inserted at the time of operation, will heal kindly. If rubber drainage is used it should not be allowed to remain long in position, since a sinus will establish itself as the tube is slowly withdrawn. The mouth of the sinus can be kept open by a small piece of tube as long as it is desirable. Of course, throughout the whole treatment most rigid attention must be given to rest and fixation of the articulation. Without this adjunct all operative treatment will fail. The great difficulty is to keep a wound continually aseptic. Care should be taken to allow as much iodoform oil as possible to remain in the joint at each dressing. When the discharge is long-continued, and the patient refuses further operation, the antiseptics must be changed every three weeks, as the tissues become accustomed to their use.

(*c*) *Erasion.* What classes of cases are suitable for erasion, and which should be reserved for excision?

These are exceedingly important questions, and the answer is frequently impossible to be determined until the exploratory incision has been made.

Erasion is especially indicated in the pulpy form of degeneration; in cases where the involvement of the articulation itself is greater than that of the bone; in children under twelve years of age where there is a prospect that by adopting this measure shortening of the limb will be prevented, and in cases where the foci of disease are few and small. In all these cases removal of the diseased hard and soft parts may be performed with confidence, and most excellent results will be obtained.

To be of service the operation of erasion must be very thorough in its character. Every particle of the degenerative material must be removed, and the knife, spoon, and gouge must be applied with vigor. The prolongation of the synovial membrane above and below the patella, wherever involved, must be taken away. When such a degree of thorough removal is possible, we may confidently hope for cessation of the disease, and even if the limb is ankylosed it will be of great service to the individual, since it will be but slightly shortened. In my experience, relapses are less frequent when ankylosis in the straight position has taken place than when motion has been secured.

Every care must be taken by frequent douching during the opera-

tion to prevent infection of the surrounding tissue, and especially by the use of a hollow flushing gouge.

There are two methods of dressing such a wound; the preferable one is by thorough packing with iodoform gauze and then closing with previously inserted sutures at the first dressing. Drainage-tubes may be employed in cases where it is uncertain that the entire deposit has been removed. The skin wound is closed except at the points of exit of the drainage-tubes, and the cavity thoroughly washed with iodoform oil (10 per cent.) at each dressing, after washing with bichloride and with peroxide of hydrogen in order to guard against infection.

(*d*) *Excision.* When there has been prolonged suppuration, or where there are evidences of a large amount of dead bone, or where the patient has suffered from prolonged drain, especially about the age of puberty and in the majority of adults, excision becomes imperative. Of course, it is resorted to with much less frequency than in former years, since the introduction of erasion; but in the cases above alluded to it is an operation of extreme value. In children under twelve years of age it is always well to avoid interference with the epiphysial growth as long as possible, in order to prevent the great shortening of limb so frequently seen when early excision is performed. Tenotomy and fixation or erasion, as already described, will often succeed in preventing this more mutilatory operation.

If excision is determined upon the operation should be thorough, but it is not always necessary to remove the entire diameter of the bone to a point as high as the extreme focus of disease. These foci may be gouged or scraped out, thus avoiding the extreme shortening which occurs when large excisions are made.

There have been different incisions proposed for this operation. I find nothing better than the ordinary horseshoe cut with convexity upward or downward, with division of the tendo patellæ. The incision should commence well upon the sides of the condyles to permit free inspection of the joint, which also facilitates drainage, and is in every way satisfactory. The straight incision with sawing of the patella, I do not like, as union of the bone is no more probable than union of the tendo patellæ, if the latter is carefully sutured. Very frequently the patella has to be removed, and for removal the straight incision offers no advantages over the curved one.

The question of drainage in excision of the knee must depend upon the judgment of the surgeon. If the wound has been thoroughly cleared and thoroughly dried, then drainage may be omitted, the gauze packing before described being employed; in the majority of old suppurative cases, however, it is better to introduce a tube, at least for a few days.

The use of an Esmarch bandage renders the area of operation bloodless, and thus greater opportunity is secured for removal of all the diseased tissue; but it certainly favors subsequent oozing. Filling a wound with a blood-clot, as advocated with many surgeons, I have not found to hasten union.

The question of fixation of the excised ends has been the subject of much controversy. The use of ivory or steel nails, screws, wiring, kangaroo tendon or silkworm sutures, and various other methods have been advised. For myself, I prefer to depend upon the external splint entirely, believing that the methods mentioned do not favor union, and that their only recommendation is to secure rest of the parts. This can be done by other means; therefore, I apply immediately a plaster-of-Paris cast. Plaster-of-Paris necessarily becomes soiled by the oozing of blood and serum, but in itself it is so much of an antiseptic that it will remain sweet for a long time, and decomposition will not take place for a number of weeks. When removal is necessary the splint can be slit into anterior and posterior halves by sawing down either side, and the cap can be removed without disturbance of the limb.

When partial healing has taken place a second cast can be applied, made strong anteriorly, through which a large lateral and posterior window can be cut for dressing purposes.

Arched iron strips surrounding the joint and fixed by wide gypsum enclosures of thigh and leg are convenient for subsequent dressing, but do not hold the joint as perfectly in position as does the simple incasement of plaster-of-Paris. The same may be said of the bracketed splint so frequently employed.

(*e*) *Amputation.* The removal of the limb in adults is in many cases of extensive diseased joints the wisest procedure. In any case of doubt an exploratory incision into the joint gives the opportunity either for an excision or an amputation.

IV. Hypodermatic Injections of Anti-bacillary Substances.—My experience with this method has not extended beyond fifty cases, too small a number to draw any conclusions of value. I am still testing it carefully, and while I have had excellent results in cases treated early, yet in this same class of cases I have also had good results without this procedure. The curative effects of this measure, therefore, are still uncertain, as far as I am concerned, especially as I invariably employ in addition all the mechanical measures so necessary for success. I have always been extremely careful to secure the most absolute aseptic condition of person and instrument, yet suppuration has followed in a number of instances; probably it would have occurred under any form of treatment. Rise of temperature, pain, etc., have taken place so speedily that I cannot but feel that the disturbances have been due to the injection. The objections are that it is painful and a source of great alarm and distress to children. Thus far I have had no cases of iodoform poisoning, but a certain per cent. will doubtless occur.

V. Removal of Late Deformity.

1. Tenotomy.
2. Forcible straightening.
3. Osteotomy.
4. Wedge-shaped excision.

1. *Tenotomy.* For the correction of flexion without ankylosis, even with slight posterior displacement, tenotomy of the hamstring tendons is the best operation in the young, since, if accompanied with subsequent fixation with gypsum, it will in the future give an excellent position of limb, often without ankylosis. Opportunity is thus given for the lengthening of the bones by growth. In performing tenotomy care should be given to avoid the popliteal vessels and the peroneal nerve. Where there is thickening or contraction of the connective tissue in the popliteal space, an open incision is desirable rather than a subcutaneous one, as much less risk is thereby incurred. With asepsis, good results can be obtained in nearly every case. Few surgeons feel safe in cutting blindly in the popliteal region, and with improved methods of technique the open plan will in chronic cases be more satisfactory.

2. *Forcible straightening.* Forcible extension should be applied

with great caution in the majority of cases, even if there is false ankylosis, lest posterior displacement be produced or inflammatory symptoms be aroused. Manual extension is by far the safest plan, and should be performed after subcutaneous or open section of the hamstrings. The contracted tissues should be slowly stretched and torn until the limb can be brought to a straight position, where it should be retained with a fixed dressing of gypsum.

Forcible instrumental replacement is also very effective.

The cases best suited for operation are those in which indications of tubercular infiltration and thickening about the articulation are minor in degree. In cases where there is much tuberculous deposit it is very dangerous to arouse fresh inflammatory conditions, lest rapid degeneration and suppuration take place.

I have operated upon a number of the first-described cases in this manner with unusually good results without pain or inflammation, and with subsequent ankylosis, thus securing an excellent walking position. This result I largely attribute to the absolute immobility secured by plaster-of-Paris and to retaining this immobility until ankylosis has taken place; then compelling the patient to walk upon crutches from six to nine months afterward, and afterward fixing the knee-joint by apparatus for a year or two to prevent relapse.

3. *Osteotomy.* When there is ankylosis with deformity at a right angle, osteotomy is not advisable, since the angle at which the fragments of the femur are placed is so great that it is not likely to be a useful weight-bearing member. Excision in this case is the better operation. If the angle of ankylosis is moderate, however, osteotomy of the femur above the condyles may be performed with advantage. Rectification of the deformity and subsequent fixation with gypsum until thorough union is established will give a most useful limb.

It is well in these cases, as in all other operations for the rectification of knee-joint deformity, to prevent walking for a long period of time, and to protect the joint from traumatism for a number of months afterward, as relapse is very common. Osteotomy is certain to give good results without suppuration if careful cleanliness is enforced.

4. *Excision.* Excision, more or less wedge-shaped, is indicated in right-angled deformity in all cases where the deposit about the

knee is great and the ankylosis bony. The method of making the section will vary with the surgeon's ideas, and his eye must decide upon such section as will bring the bone to a degree of very slight flexion rather than that of hyper-extension. In regard to fixation of the fragments the same remarks will hold good as in cases of ordinary excisions. If thoroughly and cleanly performed, immediate closure and fixation can be secured. An Esmarch bandage assists in the rapidity of the operation, and its removal early will permit the oozing to cease before the wound is closed.

VI. Backward Displacement.—I know of no mechanical method for the gradual relief of backward displacement which is at all satisfactory. Such a condition necessarily indicates that the ligaments have been more or less destroyed, and as the posterior thigh muscles are stronger than the anterior, besides being placed in much better position for mechanical action upon the bones, slow yielding in this direction must occur. I have seen numerous most elaborately constructed splints which were models from a mechanical point of view, but which were absolutely worthless as far as any effect upon the bones was concerned, since the tissues in the popliteal space become so sensitive under even slight continued pressure that little good can be accomplished.

Occasionally double extension, long continued, will occasionally draw the leg forward upon the femur. Traction should be made in the flexed position upon the lower leg with adhesive strips, weight and pulley; while a well-padded band presses behind the head of the tibia and is attached to a cord passing over a ring in the wall or ceiling, with a weight adjusted carefully to the endurance of the tissues to draw the displaced tibia forward. It has succeeded to only a slight degree. Wedge-shaped excision, with section of the ligaments, answers best, but no more bone must be sacrificed beyond the actual amount of diseased tissue than is just sufficient to relieve the deformity.

Conclusions.

1. Mechanical treatment by rest, fixation, and crutches, either axillary, perineal, or ischiatic, is absolutely essential both before and after operation.

2. In children under twelve years of age conservative measures

should be carried to the extreme, and all operative procedures should tend to non-interference of the epiphysial line for as long a period as possible. In these young cases, therefore, tenotomy with subsequent fixation should be the primary procedure, to be followed by erasion when necessary, and by excision only when life is absolutely threatened.

3. In children from ten to fifteen years of age conservatism should still be the rule, although the dangers from a shortened limb subsequent to operation are not so serious after growth is completed. In adults operative procedures should be early but more radical in character, erasion still being preferable to excision, except in serious degenerative cases.

4. Amputation in children should be employed as a *dernier ressort.* In adults with extended disease it is often a wise procedure.

5. The injection of anti-bacillary substances, both extra and intra-articular, offers hope of relief; but this method is yet in its experimental stage.

6. After the subsidence of all inflammation, the late deformity should be overcome first by simple measures, as tenotomy with forcible replacement, excision—rarely by osteotomy.

THE HISTORY OF THE TREATMENT OF TUMOR ALBUS OF THE KNEE.

By J. D. GRIFFITH, M.D.,
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Epidemics and wars have each undoubtedly sent their millions to join the great majority. In the opinion of your writer the tubercle bacillus, in its quiet and ever-multiplying and stealthy way, has caused more deaths than all other germs and battles combined. The danger to our race, including particularly civilization at the present day, is greater from this little bug than from all else beside.

Hippocrates, although in possession of no definite facts, must have known something of phthisis.

Petit and Boerhaave speak of a softening of the ends of, or a destructive process in the epiphyses of, the long bones, extending from within outward, which we now know was undoubted tubercular osteitis. Some of the most prominent surgeons at this date regarded this trouble as a molecular death or a slow inflammatory process having origin in the interior of the medullary canal.

Sir Astley Cooper speaks of a tubercular osteitis as a spongy exostosis. Wiseman, of England, was the first to give us the name "tumor albus," also a clear-cut history of a tubercular knee-joint. This term "tumor albus" he applied to all scrofulous joints. Bell was the first to give us as a cause trauma, with a scrofulous antecedent. Assuming that all tissues of the body, hard or soft, could take on the same disease, Nélaton, applying Laennec's theory, found tubercular foci in the condyles of the femur. The writers from 1807 to 1840 seem to have made a marked distinction between "tumor albus" and scrofulous disease of the knee-joint. The welding of these two seems to have been left to Rokitansky. Virchow and Volkmann show us that most terrible and destructive tumor albus can

have its origin in the synovial membrane as well as epiphysial osteitis. Long before the renowned Koch demonstrated the bacilli of tumor albus, Billroth and König had clinically demonstrated the tubercular nature of the disease.

In speaking of the topography of bone and joint tuberculosis, Dr. Senn, in his most excellent work, says: "It is safe to state that before puberty the primary lesion in tubercular affections of joints is most frequently located in one or both epiphyses of the bones which enter into the formation of the joint; while in adults, primary tuberculosis of the synovial membrane is of more frequent occurrence."

When we come to apply the general rule to tumor albus of the knee, Willimer's investigation shows that in patients under ten years of age the synovial membrane is primarily attacked in 39 per cent., and in 61 per cent. one or both of the articular extremities are the primary starting-points; between ten and twenty, 49 per cent. are synovial and 51 per cent. osseous; above twenty years of age, 33 per cent. are primarily synovial and 65 per cent. osseous. As Dr. Senn very plainly states, in the osseous form of tuberculosis the primary disease of the bone attacks most frequently the epiphysis itself. The extension of the disease beyond the epiphysial line is very unusual.

Cheyne, in his collection of cases, shows plainly that the vertebræ are the most frequent seat of tuberculosis of the bones, and next we have tumor albus of the knee. Culbertson, in his collection of 3908 cases of excisions of the large joints, shows that there were 745 operations on the knee.

Billroth, Jaffe, König, and Schmalfuss, in their clinics, all show that the knee-joint is the most frequently affected by tuberculosis. Schede's immense clinic goes to prove the same. This (the knee) is the largest joint of the body; it is the most exposed, hence the latent tinder-pile is easily ignited at this point.

The internal condyle is the most frequent seat of tubercular invasion in tumor albus of the knee, and next the head of the tibia. The patella is very seldom, if ever, the location of the primary lesion. (There are, however, one or two specimens in the museums on the Continent where the disease is supposed to have begun in the patella.)

In figuring up ultimate results we find that bone tuberculosis may

undoubtedly lead to infection of distant organs, or to a general miliary tuberculosis. Reinfection of the body, as Dr. Senn says, from a tubercular focus in the bone, takes place either directly through the veins or indirectly through the lymphatic channels; hence we shall observe in the statistics so many cures after amputation.

As far back as 1678 we find a case of tumor albus of the knee treated by Dijon, of France, by cataplasms, vesications, and cautery, finally terminating by incision and evacuation of pus, followed by death. In 1730, in Paris, the "fad" for tumor albus was the application of fomentations and the administration of herbal potions and Venice turpentine. The length of treatment for cure of the cases at this date was ten years. In 1762 Filkin, of Northwich, resected the knee-joint for tumor albus, the patient living twenty years. In 1779 Desgranges, of Lyons, used in his treatment decoctions of aromatic herbs, cataplasms of cow-dung, which he says afforded great relief. These he followed by salves of beef-marrow, dwarf elder, and marjoram; these, combined with rest (as he speaks of even passive motion giving pain and causing a change in the application to the parts of emollient pulps and the administration of horehound and thermal mineral waters), followed by cure.

In 1781 we find that Park, of Liverpool, made a resection of the articular parts of the bones and the patella for a diseased condition (undoubtedly tumor albus), and the patient made a slow and tedious but good recovery, giving the doctor a very great surprise. We find that the operation of resection for tumor albus of the knee was done in France as early as 1792, in Holland in 1809; but in Germany cures and complete recoveries were accomplished in this disease by rest, the use of cooling and evaporating lotions, as, for instance, naphtha, alcohol, lead and sal ammoniac, and the miraculous healing-stone, this latter succeeding sometimes in six weeks(?). Not until 1830 was a resection made for this trouble in Germany. This was done by Jaeger. Now we find that from 1829 to 1836, on the Continent as well as the British Isles, Arnal, Sabatier, and Weir, of Glasgow, used not only the lotions and oils, but frictions and active counter-irritations, and, finding these to fail, resorted to amputation, with resulting rapid recovery.

In 1836, in London, we find an account of the use of fixation and the cradle for this disease; and from this time to 1847 we find the treatment

across the water principally of an expectant nature, and very nourishing diet, combined with partial if not complete fixation, allowing Nature to make her own openings; also quite a number of cases of amputation; resection being resorted to occasionally. The first intra-articular injection seems to have been made by Robert, of Paris, in 1847 (puncture and injection), followed by recovery. Next came Stephen Smith, of New York, with intra-articular injections with iodine. The case not doing well, an amputation was resorted to, and recovery was complete. The first resection for tumor albus of the knee in this country was done by the distinguished Gordon Buck in 1844. In 1858 Ancelet, of Paris, treated these cases by puncture with a large trocar, emptying the synovial sac, and injected as much cold water as possible, using fixation.

There is no doubt that it is much easier to obtain the statistics and method of treatment used in the Old World than in our Western hemisphere. A great many of our good surgeons, in answering my cards of inquiry, have replied by saying that they have treated and operated upon numbers of cases of tumor albus of the knee, but cannot give me any accurate account of such at present. Following we have from the record at Washington:

Foreign—	Total.	Cured.	Died.	No report.
Amputations	280	157	83	40
Excisions	1245	814	43	388
Arthrectomies	137	77	9	51
Fixation	55	46	4	5
Injections	22	6	2	14
Extension	19	12	3	4
Expectant	33	9	17	7
Total	1791	1121	161	509

Cases not Classified.—England, 1872, 1 case: treated by sulphuric acid; cured.

France, 1852, 1 case: cautery; died.

France, 1825, 1 case: cataplasms, blister, leeches, cautery, and incision; died, lung trouble.

France, 1858, 1 case: leeches, rest, Vienna paste, and injection; cured.

	Cured. per ct.	Died. per ct.	Not reported. per ct.
Amputations	56	29	14
Excisions	65	3	31
Arthrectomies	56	6	37
Fixation	83	7	8
Injection	27	9	63
Extension	63	15	21
Expectant	27	51	21

AMPUTATION.

	Died.	Cured.	Not reported.
England	10	52	12
United States	37	42	16
Scotland	2	6	0
Ireland	0	2	2
India	0	1	0
Holland	1	3	0
France	24	30	5
Russia	0	6	0
Germany	7	10	5
Austria	2	3	0
Sweden	0	1	0

EXTENSION.

	Died.	Cured.	Not reported.
England	1	29	5
United States	5	394	163
Ireland	0	0	1
Holland	0	1	1
France	0	0	17
Spain	0	1	0
Italy	36	11	6
Russia	0	2	0
Germany	1	376	195

ARTHRECTOMIES

	Died.	Cured.	Not reported.
England	0	18	0
France	3	35	41
Germany	2	0	1
Austria	1	3	0
Russia	0	1	0
United States	3	16	6
Holland	0	1	3
Italy	0	3	0

FIXATION.

	Died.	Cured.	Not reported.
England	0	24	3
United States	1	11	0
Austria	0	1	1
Holland	1	4	0
France	3	3	1
Russia	0	2	0

Injection.

	Died.	Cured.	Not reported.
England	1	2	4
United States	1	0	2
Austria	0	1	1
France	0	0	1
Russia	0	2	0
Sweden	0	1	0
Germany	0	0	6

Expectant.

	Died.	Cured.	Not reported.
England	3	5	1
United States	1	1	1
Holland	0	0	2
France	9	1	3
Russia	2	0	0
Sweden	1	0	0
Germany	1	2	0

Extension.

	Died.	Cured.	Not reported
United States	0	4	0
England	1	5	0
France	2	3	4

In König's work of 1884 we find that from conservative treatment before the use of iodoform injections, 33 per cent. of tumor albus of the knee recovered with useful joints. At the present, however, he reports at least 66 per cent. of recoveries, with very fairly useful members, using the iodoform and fixation treatment. Notes from the archives to 1888 show in his clinic 100 cases of resection of the knee-joint between the ages of twenty and sixty-six. Six of this number died from the operation (shock evidently); 6 in a few months thereafter from secondary trouble; 16 of these cases remained uncured, 8 of which were afterward amputated, leaving a total number of 64 cures. Several years afterward, out of the 64 cured, we find that 18 of them died of tuberculosis of the lung.

In reply to inquiry as to methods of treatment, we have the following:

Mudd, H. H. Rest and counter-irritation, amputation and excision.

Bradford, E. H. 100 cases of his own, and in clinics 100 cases each year. Results very satisfactory. Erasion, excision, and conservative. Fixation and amputation, or fixation and plaster-of-Paris,

in subacute and chronic; and fixation and traction in bed in acute. When suppurating, incision and erasion, excision and amputation.

KERR, JAMES. Favors extension and iodoform injections.

MCLEAN, R. A. Free horseshoe incision and removal of all diseased tissues and a thin plate of bone. Fixation of bone with heavy wire suture.

PORTER, N. F. One cure by incision and drainage. Fixation of the joint. Iodoform injection failed. One more cure by incision and drainage and fixation. No iodoform injection used. One not cured.

ASHHURST, JOHN, JR. Usually practised excision, with good results.

WILSON, H. A. Promised cases later.

WEEKS, S. H. Excisions as a rule, and satisfactory. Some amputations.

WYETH, J. A. Will endeavor to get a list.

NANCREDE, C. B. Usually rest and counter-irritation, and if this failed, excision. Now iodoform injection, 10 per cent. in glycerin and water. If not cured, then erasion and free use of iodoform.

WILLARD, D. F. Generally rest and fixation. Results depend upon how early and how carefully treated.

STEELE, A. J. Immobilization with plaster and leather splints. High shoe and crutches. Results, stiff joints in good position. Fair motion in some; one excision cured.

RIDLON, JOHN. 600 to 800 cases from 1881 to date. Fixation by mechanical device. *Cures in all cases.* "I believe that excision is never justifiable in children, and never in adults except as a time-saving measure and on the choice of the victim."

BURNAYS, A. C. 20 cases. Majority came in when nothing but resection could be done. Resection 14 times, 2 deaths. 12 recoveries, with useful ankylosed limbs. 2 died since of phthisis pulmonalis. 6 cases by fixation with long plaster-of-Paris splints; 5 satisfactory results.

MORTON, I. S. H. Prolonged immobilization and counter-irritation and early excision.

CALE, G. W., JR. 6 resections and 6 cures; 3 arthrectomies and 3 recoveries; 1 amputation and 1 recovery.

RUTH, C. E. 4 amputations, 1 death and 3 cures.

Langdon. 4 expectant, result not given. 1 fixation, cured.

Mynter. 11 cases, trephined 4, and 7 excisions. 4 arthrectomies, and 1 arthrectomy died.

Pilcher. 21 cases. 8 excisions, 7 cures and 1 death; 8 fixations and 8 cures; 2 arthrectomies and 2 cures; 3 amputations and 3 cures.

Gaston, McFadden. 2 amputations, and no results given.

Fowler, George. Kings County Hospital, Brooklyn, in 1880. 66 excisions. 6 died; 39 recovered; 8 subsequently amputated; 13 not recorded.

Griffith, J. D. 36 cases. Deaths, 1, from general tuberculosis; guaiacol used internally in 32 of the cases. Treatment: excisions, 12; incision and iodine, 6; fixation, 10; washing out and fixation, 1; opening, draining, and fixation, 1; arthrectomy, 4; amputation, 1; Fixation and iodoform injection, 3.

The following statistics were taken from Dr. Senn's work:

1 case with injections of iodoform emulsion, followed by "Koch's lymph," no result; 1 case by "Koch's lymph" alone, no result; 5 cases with iodoform injection, 4 cures, 1 failure; 1 case by resection, cured; 1 case by arthrectomy, cured.

When we come to sum up the treatment of tumor albus of the knee, the profession, from Hippocrates to the present, seem to have deemed it essential that it should be both general and local; the local affection is but a manifestation of the existence of a tubercular focus in another part of the body. Hence we have it established as a rule, as Dr. Senn says, that whatever contributes toward the improvement of the general health of the patient retards the progress of the local lesion and brings about the most favorable conditions for a spontaneous cure, and at the same time greatly adds to the success of any operative treatment.

Hygienic surroundings, especially where we deal with children—as very frequently the foundation for tubercular gonitis is laid during the period of growth and development of the skeleton—should be carefully looked into, since we now know that an inoculation of the bacilli may take place in greater or less number in quite a number of different ways. Fresh air, bathing—and hallowed be the physician who, when he has finished his work, can have inscribed upon the marble that marks his resting-place, "He fed his patients." If

ever a disease needed food and perfect assimilation, this is the one. As we see, from some of the older histories, internal remedies have been resorted to from time immemorial. Cod-liver oil, iodine and its preparations, iron, arsenic, and mercury all seem to have had their places as general systemic tonics.

In 1878 Max Schuller found, under the administration of guaiacol to animals rendered tuberculous by inoculation, in the affected parts three different processes by which the lesions were cured: 1. Cicatricial contraction of the tubercle, with fatty degeneration. 2. Softening of the nodules followed by vascularization of the tubercular tissue. 3. Ulcerative destruction of the tubercle, with cicatricial contraction and healing.

Since this time (1887) Max Schuller has treated every case of tumor albus of the knee with the administration of guaiacol (of course, accompanied by conservative measures).

Since our last meeting a year ago, in New York, I have had no cause to discontinue the use of guaiacol; we are now using it in double the number of cases of tuberculosis in bones and joints. In fact, we have followed the Max Schuller treatment in every case of tubercular joint trouble that has fallen into our hands, and have yet to see a case—where the lungs are not involved—that has not improved by its use. Of course, where we find that a stomach is disposed to reject it, we at once substitute the soluble pills of creosote, as good beechwood-tar creosote contains 90 to 95 per cent. of the guaiacol. (We understand that Merck is now attempting the manufacture of a guaiacol capsule.)

We hope that the time is not far distant when we may be in possession of a single remedy which will act as a specific on tubercular tissue as surely as iodine or its preparations do on syphilitic products.

No matter how well planned and executed the general treatment may have been in tumor albus of the knee, it has never supplanted the fact that local attention was an absolute necessity, consisting of means whereby the knee could be placed so that it would undergo spontaneous recovery—the ideal result. Whereas we see frequently (unfortunately) this result is no longer attainable on account of the great structural changes, some means have been adopted for rendering harmless the infected area, or, this not succeeding, elimination has been the next step.

Rest, absolute physiological rest, rest in bed, in the treatment of tumor albus of the knee, has been a cardinal point, as well here as in inflammatory processes in any part of the body, be the cause what it may. Rest combined with some method of immobilization of the tuberculous knee is, as we see, a time-honored method of treatment.

Fixation of the knee-joint, unless there is already erosion of the cartilages, be it continued for ever so long, will not lead to permanent ankylosis. I am well aware that this is averse to some of the best authorities, but experience is one's best teacher. That fixation is the consensus of opinion in the treatment of our present subject, is beyond any doubt, as we find it mentioned and pursued as far back as we can trace. Again, the "let alone the broken-down material" treatment, brought forward several years ago by one or more members of our Association, has certainly yielded most remarkable results.

Extension as a therapeutic agent in surgery was brought forward by Guy de Chauliac. Extension for the correction of deformity in tumor albus of the knee, combined with fixation, has been of undoubted service since Swift, of Pennsylvania, first used the adhesive strips for this purpose. The beneficial results from this method seem to be due principally to the abatement of muscular spasm, and the consequent rest secured to the joint.

The moxa, seton, and counter-irritation of all kinds have seemingly been of little service. We are now well aware of the fact that external remedies of every description exert very little or no direct healing powers on intra-osseous or intra-articular lesions. It may be urged, however, that by the improvement of the circulation in and around the knee, the healing process may be favored. Blisters here, as over the head of the colon in appendicitis, only serve to interfere with examination and diagnosis and irritate the patient.

Brisement forcé for deformity of tumor albus of the knee has long since given way to osteotomies and excisions.

The applications of cold and heat, both have seemingly yielded some good results; especially do we find this treatment used in the older histories. Cold we know should be used during early stages or acute exacerbations. After stasis has taken place it has been found harmful; the sensation of the patient under these circumstances is an acute guide.

We find that massage and electricity have each taken a hand in completing the cure of tumor albus of the knee.

Tuberculin, as used by Koch, has proved a failure in the treatment of tubercular osteitis or capsular trouble of the knee.

When we come to intra-articular injections, we find iodine was first used with some degree of success. Carbolic acid, arsenious acid, bichloride of mercury solution, phosphate of lime, chloride of zinc, and camphorated naphthol, have each had their adherents and no doubt have each been of some service in the arrest of this trouble. We all can remember the wonderful success of Dr. Lewis A. Sayre in the use of balsam of Peru in his operations on tubercular joints.

In 1883 Billroth, Mikulicz, and Moorhof taught the use of the safest and best therapeutic agent we have for intra-articular use—iodoform.

In his conclusions Dr. Senn very justly says: "Of all substances now employed in this method of treatment iodoform has yielded the best results. The curative effect of iodoform in the treatment of local tuberculosis is due to its antibacillary effect and its stimulating action on the healthy tissue adjacent to the tubercular product."

A 10 per cent. emulsion in glycerin or pure olive oil is the best form in which this remedy should be administered subcutaneously.

The ethereal solution should never be employed, as it is liable to cause necrosis of the tissues overlying the abscess and iodoform intoxication.

Tubercular abscesses and joints containing synovial fluid or tubercular pus should always be washed out thoroughly with a 3 to 5 per cent. solution of boric acid before the injection is made.

Injections should be made at intervals of one or two weeks, and their use persisted in until the indications point to the cessation of tubercular inflammation and the substitution for it of a satisfactory process of repair, or until the result of this treatment has shown its inefficiency and indications present themselves of the necessity of resorting to operative interference.

If the treatment promises to be successful, symptoms pointing to improvement manifest themselves not later than after the second or third injection.

Arthrotomy, arthrectomy (typical or atypical), or amputation for tumor albus of the knee are not now nearly so common as a few years ago. Nor should any operative interference be thought of until *rest*, immobilization, and iodoform injection have been tried most thoroughly.

THE IDEAL KNEE SPLINT.

By JOHN RIDLON, M.D.,
CHICAGO.

The ideal splint for the treatment of disease at the knee-joint is one that gives 100 per cent. of immobilization and at the same time protects the joint from the traumatism incident to locomotion.

The early form of the Thomas knee splint, the one with the patten bottom, which is pretty generally used in this country, was markedly in advance of all the short splints and of the splints making traction from adhesive plasters applied from the knee upward and downward; but the splint lacked somewhat in power to immobilize, and on that account confined the patient to bed unnecessarily long. Besides this a high patten was required for the opposite leg and the apparatus became a clumsy one.

The form of splint to which I wish to call attention is not new; it was used to the exclusion of the "patten" splint by Mr. Thomas for at least four years prior to his death, and has been exclusively used by Mr. Robert Jones and myself since that time. It was called by Mr. Thomas the "Caliper" splint, and may be readily made without the help of the instrument-maker, from the "bed" splint.

The bed splint consists of a ring of iron wire to which is welded a long loop of the same wire (Fig. 1). The ring, in shape, is an irregular ovoid, flattened in front, and drawn out at the posterior and inner portion so that when padded it shall fit the upper circumference of the thigh (Fig. 2), and as here observed, the inner wire of the loop, B, is joined more anteriorly than the outer wire, C. The ring slopes from without inward, and from before backward in such a way that the point, A, upon which rests the tuberosity of the ischium is the lowest part of the ring. Fig. 3 shows front view and

FIG. 1.

FIG. 2.

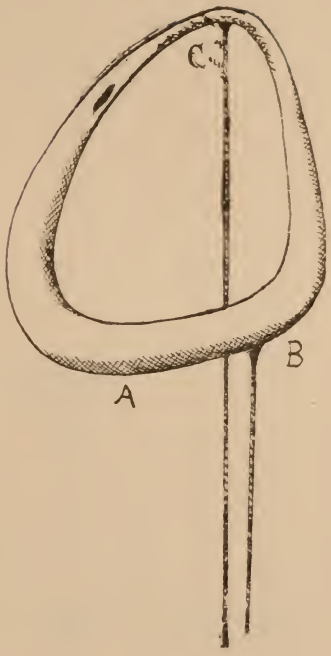


FIG. 3.

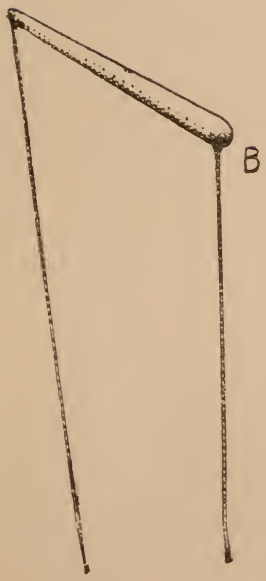


FIG. 4.

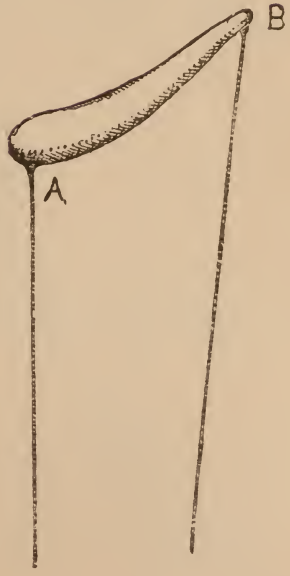


FIG. 5.

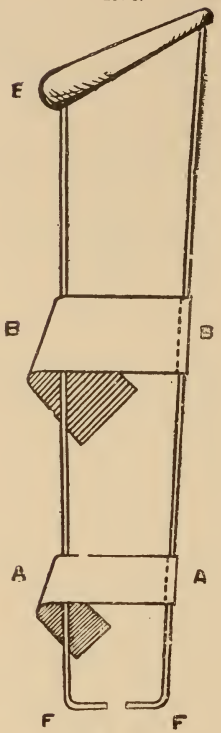


FIG. 6.

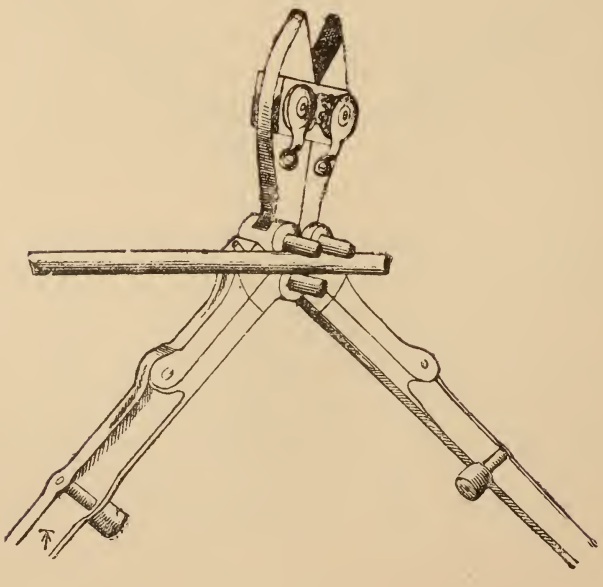


Fig. 4 the rear view. The angle formed by the lateral plane ring and the inner bar is about 135°, and the anterior angle formed by the antero-posterior plane of the ring and the inner bar is about

Fig. 7.

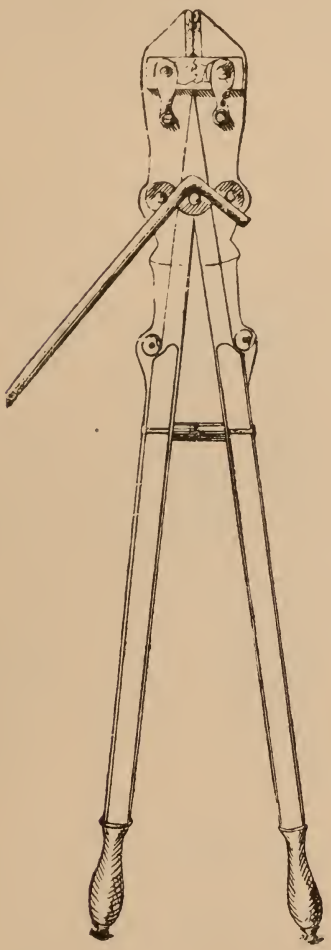
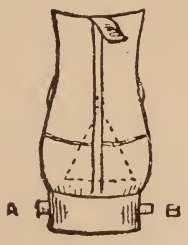


Fig. 8.

Fig. 9.



145°. The wire used depends upon the weight of the patient and is from three-sixteenths to three-eighths inch. In making the ring, the ends should be joined by welding, and the side-bars of the long loop are joined to the ring in the same manner. Few

surgical instrument-makers are good blacksmiths and therefore find it easier to braze than to weld, but a brazed joint breaks on bending, while a welded joint holds fast. The lower end of the long loop is dimpled somewhat to receive and retain the strap from the adhesive plasters. The ring is padded with boiler felting to the

FIG. 10.

FIG. 11.

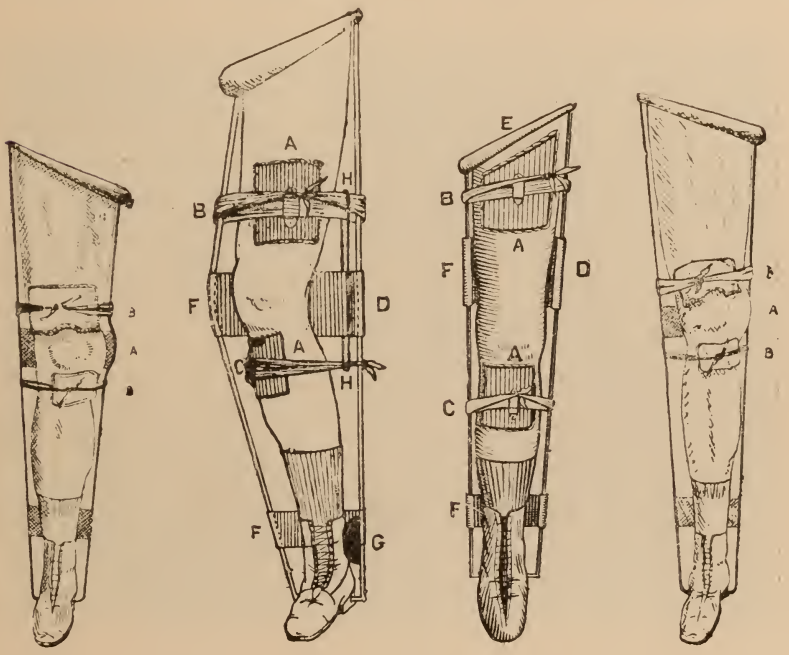
FIG. 12.

thickness of about half an inch in its outer portion, and from an inch to an inch and a half in thickness at the inner posterior portion upon which the tuberosity of the ischium is to rest, and then covered with basil leather (tan sheep-skin), put on wet, and sewed after the manner of the harness-maker along the lower and outer border of the ring, *i. e.*, where the seam will not chafe the patient. Two strips, from three to four inches wide, of the same leather are

sewed to one of the side-bars, the other end being left free and of sufficient length to be drawn across to the opposite bar, and when sewed there form a support to the back of the limb when the splint is applied; one of these strips is to be back of the knee and the other back of the ankle.

The splint is applied by slipping the ring on over the leg and pushing it well up against the tuberosity of the ischium. If fixa-

FIG. 13. FIG. 14. FIG. 15. FIG. 16.



tive traction is to be used, strips of strong adhesive plaster, in width about one-fourth the circumference of the leg, and in length equal to the distance from the knee to the ankle, to the lower ends of which pieces of strong tape, webbing, or muslin bandage have been sewed, are applied to the outer and inner surfaces of the leg; if these pieces of adhesive plaster are supplied with narrow, oblique, lateral strips for winding around the leg, they will remain much longer attached to the skin. The plasters applied are held in place by an ordinary bandage. The surgeon now grasps the

patient's foot and pulls steadily downward, at the same time pushing the splint upward, and having straightened the limb as much as the patient will tolerate, ties the tape terminations of the adhesive plasters at the dimple, or upward bend, at the lower end of the splint. The lower leather cross-strip is now placed back of the ankle, drawn snugly across, and sewed fast. The other leather strip is placed back of the knee, or back of some part of the thigh if the knee is too greatly flexed to rest upon it, and it is drawn

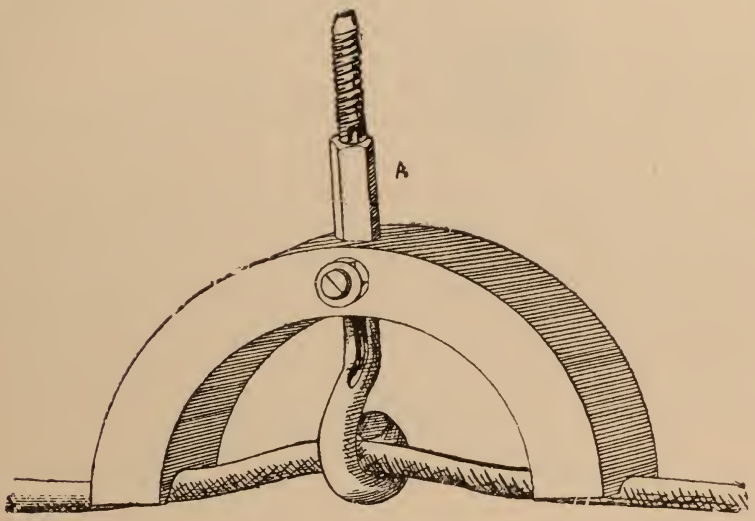
FIG. 17.

across to the opposite bar and sewed there. The knee is now pressed backward, straightening it as much as the patient will tolerate, and held there by a roller bandage carried back and forth across the front of the limb, and around first one side-bar, and then the other; or a thick pad may be placed across the lower end of the thigh, well down upon the patella, and backward pressure made by a strong strip of muslin bandage passed across from side to side and somewhat downward, and tied to each side-bar by a half-hitch, and then carried across the pad and tied. After this the traction tapes at the bottom are again tightened.

The limb is left thus, if everything remains in place, for two or three days, when it can again be made straighter and the fastenings made tighter. In this way the limb is straightened. If the limb is to be straightened under an anæsthetic, it is better to apply at once, after the straightening, the caliper splint which will now be described.

The caliper splint is made from the bed splint by cutting off the end of the loop and bending an inch or more of each side-bar inward at a right angle (Fig. 5). The bed splint is applied and

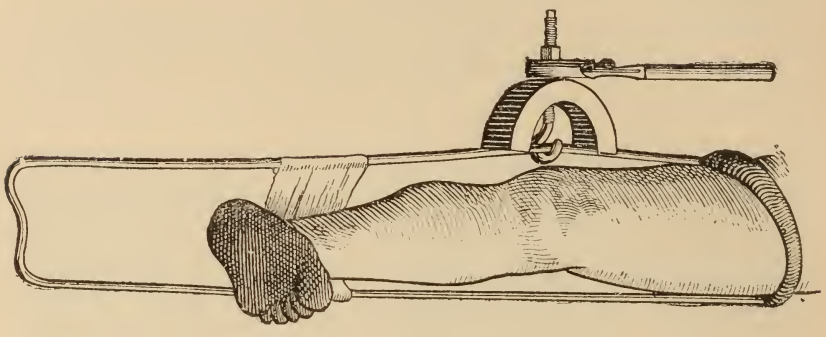
FIG. 18.



pushed well up on the straightened limb; a point is marked on each side-bar an inch below the sole of the foot, and an inch or an inch and a half below this the side-bars are cut off and the bend is made at the point marked. Figs. 6 and 7 show the tool used for cutting off these bars, and the process of bending them. A shoe is cut at the heel as shown in Fig. 8 or Fig. 9; a hole is bored through the heel (Fig. 10, line A B), or a slot made by a second hole (Fig. 11, line C D), and a tube inserted (Figs. 9 and 12). Into the hole or tube the bent ends of the side-bars are passed, the leather strips drawn fast and sewed, and the limb tied or bandaged in place, as shown in Figs. 13, 14, 15, 16, 17. If the knee is swollen so that

the inner bar presses against it, this bar is drawn outward with wrenches, or the tool (Figs. 18 and 19), employed. When a joint has been straightened under an anæsthetic, it should be left in the splint, without change of shoe, stocking, or bandages, until all pain

Fig. 19.



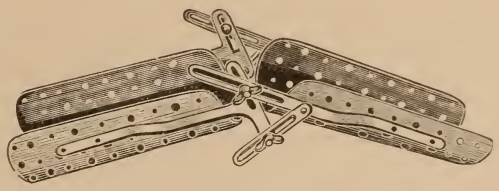
and tenderness have passed off. In a word, the joint has been more or less sprained by the manœuvre, and must be treated with all the consideration which a sprain demands.

The deformity corrected, the patient should be kept off his feet until the muscular spasm which tends to deformity has subsided; then he may be allowed to walk about. If for any reason the patient has to be gotten up before this time, he should use crutches.

A SIMPLE FORM OF KNEE SPLINT.

By A. E. HOADLEY, M.D.,
CHICAGO.

This splint is very convenient of application, simple in construction, and for a general all-round knee-splint hardly has an equal. It is composed of a thigh and leg segment which are entirely separate from each other in construction, and are to be applied to the respective segments of the limb separately, and when applied the limb is set and fixed in any position from a right angle to perfectly straight. Rotation of one segment on the other can be obtained, or lateral deviation. If desired, the splint can be applied with adhesive straps, so that powerful traction can be exercised on the



joint at any angle. That is, the joint surfaces can be separated at whatever angle the limb may be in, and with any desired degree of force. The tension of the traction, the angle of flexion, or the direction of force as to forward or backward at the upper end of the tibia in its relation to the femur can be instantly and readily changed. The knee can be inspected at any time without disturbing traction or tension, the joint itself being exposed to sight or touch all around. In resections of the joint the bones can be placed and firmly held in contact at any angle. They can at any time be changed in flexion, rotation, or extension, or held firmly with uni-

form tension. The approximated bone-ends can be shifted up or down or from side to side until the position desired is obtained, and the joint can be dressed as often as may be desired without moving the splint. As an instrument for correcting false position it is eminently satisfactory. It can be readjusted in the direction of correction every three or four days, or as often as the tissues can accommodate themselves to their new position, and correction is accomplished with the greatest possible rapidity.

The instrument will be more clearly understood by referring to the illustration.

A SIMPLE AND EFFECTIVE KNEE SPLINT.

By WALLACE BLANCHARD, M.D.,
CHICAGO.

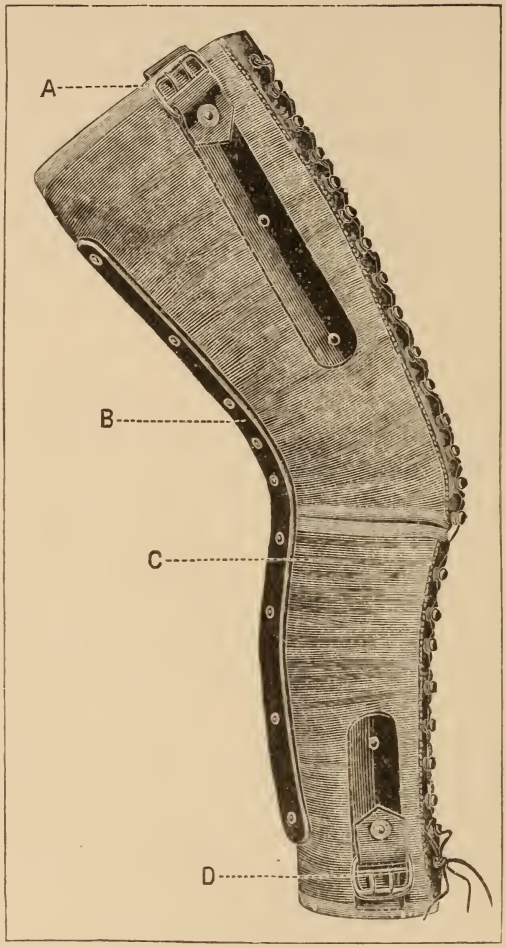
The best splint for general use in osteo-arthritis of the knee in my hands, and one that I have used with various modifications for over twenty years, is the one here presented.

It is made on a plaster cast, and is of saddler's leather, with a posterior iron bar (B), by the aid of which the leg can be placed and maintained at any desired angle; there are two buckles (A and D) at the ankle and one at the top nearly over the trochanter major for adhesive-strap extension. The division between the two sections of the splint is made on a level with the lower margin of the patella.

This splint is very easy to wear, as it fits every part accurately, with no undue pressure at any one or two points, and there are no ratchets, screws, or springs to load down the patient and get out of order. It is very light, and is indestructible. It takes advantage of the swell of the thigh, the same as a socket of an artificial leg, and with it extension and rest are well established.

In cases of chronic disease of the knee-joint, presenting the condition of posterior subluxation, a chamois pad of sufficient thickness should be placed inside the splint at about the point indicated by C in the cut, to produce forward pressure just below the popliteal space.

I believe it is accepted by all, in articular inflammation of the knee-joint as in other joints, that friction, if it does not kindle the inflammation, certainly increases it, grinding the inflamed osseous structure into detritus, and destroying reparative tissue more rapidly



than it can be produced. With this splint, movement and pressure—the two factors of friction—are as thoroughly relieved as would seem possible.

ETIOLOGY OF THE DEFORMITIES OCCURRING IN KNEE-JOINT DISEASE.

By A. M. PHELPS,
NEW YORK.

PROPOSITIONS:

1. In diseases of the condyles of the femur or the head of the tibia, the leg always assumes a flexed position to a greater or less extent.

2. After the limb flexes the foot rotates outward, and rotation increases with flexion.

3. In diseases *confined* to the patella the limb never flexes.

4. In disease of the synovial sac, or fibrous capsule, *anteriorly* unattended with diseases of the condyles—cartilage, lateral, or crucial ligaments, the limb remains straight.

In diseases of the entire joint, including the cartilages, the leg always flexes, whether there is fluid present or not.

I must qualify these propositions by saying that certain pathological changes which may have taken place, may modify these deformities. But such exceptional deformities are always easily accounted for, as, for instance, that seen in Charcot's disease, or in cases attended by complete destruction of either condyle or either side of the tibia. My observations have been made in a large number of cases upon which I have operated in the Post-Graduate and City Hospitals, New York City, and the Mary Fletcher Hospital, Burlington, Vermont, and I found that the foregoing propositions were correct, with an occasional exception, as already noted.

Many German and English experimenters have tried to account for flexion upon the fluid hypothesis. It is true that when the knee-joint is forcibly injected it will flex slightly, to give the greatest possible capacity to the capsule, but this is insufficient to explain the deformities.

Barwell does not attempt to explain them, but says (Barwell, p. 106 Wood's Library, 1881), "It is true that the flexors are probably in all limbs stronger than extensors, but in fact a mere examination will show that on the flexor side muscles are rigid, and on the opposite side flaccid. Our knowledge is as yet insufficient to account for this phenomenon."

The fluid hypothesis is wrong—why?

1. Because by far the largest per cent. of knee-joint diseases are unattended by fluid effusions. Still the same picture of deformity is seen as in those cases attended by large effusions.

2. Cases of disease, extra-capsular, located in the epiphysis of the femur, or in the head of the tibia in which the joint was not found involved at the time of aspiration, presented the same picture of deformity.

3. Large serous effusions, from synovitis or other causes, are frequently unattended with flexion.

4. After the joint is evacuated in large effusions the limb should again assume the straight position, but it does not.

These are the chief and valid reasons why the fluid hypothesis is incorrect.

The statement of Barwell, just quoted, is incorrect. I have carefully weighed the muscles acting upon the leg, and find that the flexors weigh eight pounds and the extensors fourteen pounds in the subject examined. The quality of fibre of these muscles being equal, and other things taken into consideration, the extensors would be stronger than the flexors, in the proportion of fourteen to eight, while the limb is in the straight position, as neither group would have the advantage of leverage.

Experiments to Demonstrate the Relative Strength of Each Group.

Experiment I. A man was strapped to a table, the popliteal space at the end of the table and leg extending over. He could sustain 136 pounds suspended from his foot. Turned on his face, the patella at the edge of the table and limb extended, he could now only sustain 36 pounds suspended from the heel.

These results correspond very closely to similar ones attained by Haughton, of Dublin. (See Haughton's *Animal Mechanics.*)

Experiment II. Subject standing, right leg flexed to right angle, he could hold suspended from heel 90 pounds.

In other words, the flexor group were 55 pounds stronger when the leg was flexed than when straight.

Experiment III. Subjects standing against bar which crossed the legs at right angles behind at the popliteal spaces, the left toe of foot against a spike in the floor to prevent slipping. A strap around ankle of left leg adjusted to spring scales, which were pulled upon from behind, showed a resistance of the extensor group of muscles of 240 pounds.

Same subject was strapped on his back, leg hanging at right angles over the edge of the table. The same scales were now pulled upon under the table, and it was found that a pull of 80 pounds would flex the leg still further, a difference of 150 pounds of resistance in the quadriceps group of muscles between the leg flexed and extended. Then we have this formula for extensor and flexor group:

1. Flexors, first experiment, 35 pounds.
   Extensors, same experiment, 136 pounds.
   Difference of power of each operating with equal advantage, = 90 pounds.
2. Flexors, same experiment, leg flexed, greatest advantage of flexors, 90 pounds.
   Extensors, leg straight, greatest possible advantage for extensors, = 240 pounds. Experiment III.
   Difference, = 150 pounds.

Difference in favor of flexor, limb straight or flexed, 55 pounds.

Difference in power of extensors, limb flexed or straight, 150 pounds.

This proves that the extensors are stronger than the flexors, the proportion being 240 to 90, the limb being straight to give extensors the greatest advantage, and flexed to give the flexors a similar advantage. The limb when flexed, so modifies the strength of these groups as to make the proportion in favor of the flexors as 90 is to 80.

The *extensors lose in power* as the limb flexes, while the flexors *increase in power* in about the same proportion. We all remember the futile effort of one boy to bend the other's leg by putting his

knee in the popliteal space, and grasping the foot, the other boy on his face. And again, sitting on a fence while hunting, the toes under or behind a rail, one can easily lower himself backward until the head is on the ground, and can quite easily again resume the upright position. The power exerted by the quadriceps group of muscles in such a case, acting as a pulley over the end of the femur, raising a weight of 150 pounds on the end of a lever (the femora) of nearly two feet, must be enormous, amounting to hundreds of pounds.

We will now examine a knee-joint. It is a hinge which, when in the straight position is firmly fixed, owing to the tension of the lateral and crucial ligaments. This forces the articular surfaces firmly together and prevents lateral motion. The leg flexed, there is lateral motion of the joint, which increases as the leg flexes, and not only lateral but rotary motion. This is due to the relaxation of the crucial and lateral ligaments by flexion. Another fact, the patella and a portion of the capsular, anteriorly receives its nerve supply from the obturator, and possibly from the anterior crural. The other portion of the joint is supplied from the great sciatic. The great sciatic supplies the flexor group, while the obdurator and anterior crural supplies the extensor group. A clinical fact is, that when the entire joint is attacked with acute inflammation, all the muscles surrounding it are affected by spasm. Still flexion rapidly takes place, whereas disease of the condyles always produces great spasm and rapid atrophy of the flexors, while the extensors remain quiescent. Diseases limited to the patella produce spasm and atrophy of the quadriceps extensor femoris, and the limb remains straight.

Understanding that the extensors are stronger than the flexors; that the muscles about the joint are equally affected by spasm when the entire joint is diseased, why does not the leg remain straight? Before attempting to answer the question, I desire to call your attention to these diagrams. Fig. 1, a lever with a joint at *a*. Both hands pulling 10 pounds, the bar would not flex. But in Fig. 2, the bar being flexed at a right angle, puts one string on the lever and the other around the pulley. This gives to the string acting on the lever a tremendous advantage, quite easily calculated. This is exactly what takes place when the leg flexes, and *ex-*

plains the difference in power as illustrated by my experiments. The same mechanics applies to the anatomy of the leg, roughly represented by a rude pencilling (Fig. 3). A photograph of one of

FIG. 1.

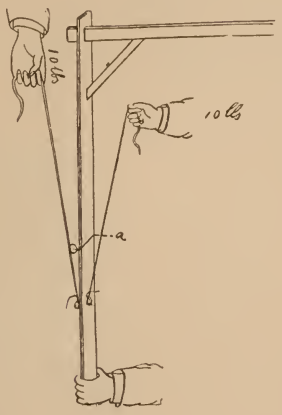
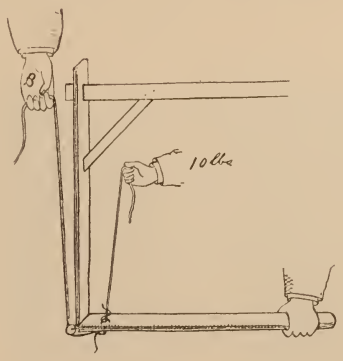
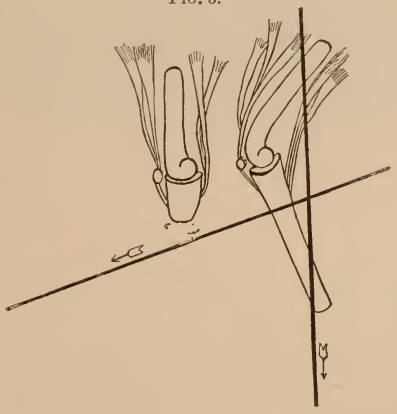


FIG. 2.



my dissections shows the biceps acting on the head of the fibula, the limb straight, and also the extensors and patella. Fig. 5, the same in flexion: biceps acting on a lever, and extensor over a pulley

FIG. 3.



(head of the femur). The muscles being dried, do not give an accurate idea of their position while contracted, as they fall in curves on flexion. Fig. 6. The same leg straight, showing inside flexors acting on the tibia. Fig. 7. The same leg flexed. It will be seen that

these flexors increase in power as the leg flexes, by being placed on a lever, and the extensors decrease by being wound around the head of the femur.

Q. Why does the leg flex when the entire joint is diseased, and all muscles are equally affected by spasm?

A. When the leg is straight the tension upon the lateral and crucial ligaments produce great pressure between the articular carti-

FIG. 4.

FIG. 5.

lage. This produces great pain, and the patient to relieve this flexes the leg to relax these ligaments. This at once relieves intra-articular pressure. But the flexion of the leg has put the flexors on a lever and the extensors on a pulley. The flexion now having the advantage, will continue to flex the leg.

Q. Why does the leg rotate outward?

A. Flexion by relaxing the lateral and crucial ligaments permits free lateral and rotary motions at the knee-joint. The biceps inserted into the head of the fibula, and being the stronger of all the flexor

group, and having the advantages of direction and leverage, rotates the leg outward.

Q. Why does the leg never flex in diseases of the patella alone?

A. Because the reflexes from the area of disease are transmitted through the obturator and ant. crural nerves, which supply only the quadriceps. A voluntary effort to relieve pain is also present.

Fig. 6.

Fig. 7.

Q. Why are the extensors relaxed in disease confined to the head of the tibia and condyles of the femur posteriorly?

A. The reflexes from the area of disease are transmitted through the great sciatic, which nerve supplies the flexors. Exceptional deformities are produced from pathological destruction of bone or soft parts.

Conclusions.—Typical deformities are produced by change of leverage and action of muscles due to

1. A voluntary effort to relieve pressure and pain.

2. Involuntary spasm and contraction of muscles, which increases the deformity by advantage of leverage due to flexion.

3. Nervous irritation of groups of muscles due to localized lesion in or about the joint.

4. Exceptional deformities are produced by pathological destruction of bone or soft parts.

5. Outward rotation of the leg is produced by spasmodic contraction of the biceps after flexion has taken place. Flexion allows lateral and rotary motion at the joint.

MECHANICAL TREATMENT OF TUMOR ALBUS.

By R. W. LOVETT, M.D.,
BOSTON.

A SPLINT which shall be suitable to control and cure cases of tumor albus of the knee-joint must provide three things: (1) Fixation; (2) protection of the joint surfaces from bearing the body-weight in walking; (3) traction upon the diseased joint, which is essential in painful cases. An apparatus or a mode of treatment which provides only one or two of these is deficient and will not yield the best results, and the apparatus which most efficiently combines the three will in the end prove the most serviceable and will cure cases, with a greater range of motion at the joint than would otherwise be obtained.

1. Fixation of the knee of a fairly complete character is furnished by plaster-of-Paris and leather splints, but if during the time of use of this apparatus the patient is allowed to bear weight upon the limb in walking, much of the good is negatived, pain and swelling return as symptoms of joint irritation, and the progress is most often bad; so little is fixation alone able to accomplish. Fixation alone with protection can, however, be obtained during treatment by a simple plaster-of-Paris splint, if one insists upon the use of crutches and a high sole on the other foot, so that the diseased leg will not touch the ground in walking. In cases treated in this way the value of traction is left out of sight, and in many cases it is not necessary; in others, however, it is necessitated by pain, which it alone can relieve.

The knee splint described by the late H. O. Thomas, of Liverpool, is sufficient to furnish in a way these three indications. It consists of a steel ring, coming well up against the perineum, which encircles the leg, following the line of the groin; to this ring are

joined two steel rods, one on each side of the leg reaching to a steel patten two inches below the foot. Leather lacings to the thigh and calf furnish fixation. A sticking-plaster extension can be made to exert traction upon the knee by buckling the ends around a bar attached to this patten. The splint is cheap and, although rough, answers well in average cases.

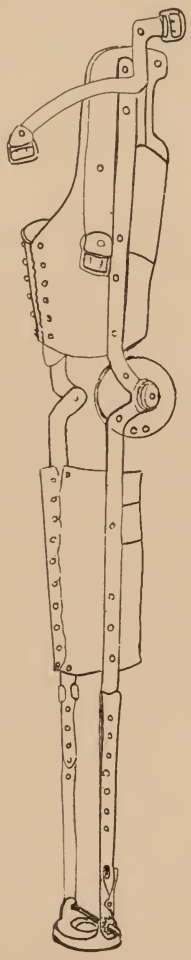
But if flexion at the knee occurs, as happens in sensitive and severe cases, it becomes at once impossible to fix the leg properly by the leather, and also impossible to make traction in the line of deformity assumed by the irritated joint. These are serious obstacles to progress, and in these cases, in the writer's hands at least, the Thomas splint fails to give satisfaction.

The splint which is to be described is, to the writer's mind, the best and most accurate appliance for the treatment of tumor albus. It is comfortable and easily worn, it fixes at any angle the diseased joint, and makes traction upon the joint in that line. Moreover, whether bent or straight, it protects the joint against weight-bearing, being a walking splint suitable for use even in very sensitive joints. The writer does not know but that the splint may have been described under some special name, although he has never seen the description, and is indebted to Dr. Bradford for the original suggestion which has led to its trial and its extended use by him.

The splint, reduced to its simplest terms, consists of two uprights, one inside and one outside the leg, jointed at the knee. To the outer upright at the top is attached an arm to carry a perineal band and to furnish counter-extension. Below is attached a windlass controlled by a key; to the pins in this windlass the lower ends of the sticking-plaster are attached and traction made by winding the windlass. At the knee by means of the disk and screws which control the various holes, the splint can be set and held at any angle. Leather lacings fix the thigh and calf, and should fit accurately to do this properly.

The patient should have a plaster extension running downward from the knee; the bottom of this is fastened to the windlass at the lower end of the splint, another sticking-plaster extension should run up the thigh from the knee, and the upper ends of the latter should be buckled to two buckles attached to the iron framework of the splint (the outer one of these can be seen in the figure).

The splint is applied as follows: the angle at the knee is arranged to fit the angle taken by the leg, whatever its position; the perineal band is buckled tightly in place, the straps of the upward extension



on the thigh are attached to the buckles on the upper part of the splint, and finally the lower straps are attached to the windlass, which is keyed up until the limit of comfort is reached. Finally, the leather lacings are tightened and the splint is in place.

It can be used with crutches and a raised sole on the other foot. It can be used as a simple walking splint without crutches by a slight high sole on the other foot, or when convalescence is established the windlass can be given up and the extensions abandoned and the lower end of the uprights can simply be slotted into a plate attached to the outside of the sole of the shoe, and the splint serves then simply as a protection splint to the knee and the hip as well simply by serving as a perineal crutch. Under the latter circumstances a joint controlled by a spring can be substituted for the disk at the knee.

The writer is glad to have a chance of advocating this apparatus as the most useful splint in all cases of tumor albus reaching even a moderate degree of severity.

THE MECHANICAL TREATMENT OF OSTEITIS OF THE KNEE.

By HENRY LING TAYLOR, M.D.,
NEW YORK.

The term osteitis of the knee, or "white swelling," is used to designate a tubercular, purulent, or mixed process, which usually begins in an adjacent epiphysis or in the synovial membrane, and, if unchecked, finally involves most of the joint structures.

Some of the classical symptoms of inflammation, namely, pain, heat, redness, swelling, and impaired function, are less marked in chronic than in acute affections; the first three may be entirely absent at certain stages or in certain types of chronic knee disease. Tenderness, especially circumscribed tenderness, is more constant and of more significance as an indication of osseous involvement, as recently pointed out by Senn; but in all stages of joint disease, where the synovial membrane is irritated, the tonicity of the muscles acting upon the joint is of more importance as an indication of the condition of the joint in difficult or doubtful cases than all the other symptoms put together, and always calls for critical examination. Atrophy of the limb above and below the joint is also a constant symptom. Whatever the irritant or pathological process, if continued and involving the joint, certain symptoms regularly appear as the result of reflex spasm acting upon the joint under the mechanical conditions present; and certain deformities regularly accompany chronic inflammation of the knee, as the expression of a tendency to a dynamical equilibrium of the different forces acting upon the joint. The thigh muscles are stimulated through reflected joint irritation, and the flexors being more advantageously placed than the extensors, the knee becomes gradually more and more flexed; from preponderance of the biceps at the outer side of the knee, and from its more

advantageous leverage through its insertion into the head of the fibula, the tibia is rotated out and abducted; and as the posterior group of muscles pull the head of the tibia directly backward when the knee is semiflexed, the head of the tibia undergoes the characteristic subluxation backward, there being no adequate force to oppose it. That is to say, the mechanical arrangement of the joint and its muscles favors flexion, eversion, abduction, and subluxation. This is also seen after poliomyelitis, where similar deformities are more gradually produced without spasm.

Under the reflected stimulus of an irritated joint, however, the muscles tend to produce, by their exaggerated but irregular tonicity, a position of less discomfort—that is, of less tension and less irritation. Volition has little to do with it. If irritation be intense, even in the semiflexed position, flexion may become excessive without relief, and in most untreated cases, where the joint irritation is considerable and long continued, eversion and subluxation and often abduction are gradually produced, clearly unaided and unhindered by volition.

The knee, if considerably damaged and left to itself, gradually becomes more or less fixed in this flexed, everted, abducted, and subluxated position, from thickening of the ligaments, adhesions, and the adaptation of the hard and soft structures to the deformed position. In certain cases bony ankylosis may finally occur, or the patient may succumb to a complicating tuberculosis, local or general, septicæmia or its sequelæ, or exhaustion. It is also true that milder grades of the affection do occur, which get well with a more or less useful joint, under comparatively simple treatment.

The indications for treatment in this affection, and also in chronic synovitis of the knee, are local and general.

The general indication for treatment is to improve the nutrition of the patient, and thus insure a blood-supply of good quality to the diseased area, to favor the reparative process. The principal means to this end are an abundant supply of fresh air, a nourishing diet, the relief of local irritation, and the correction of complicating disorders. Local mechanical treatment is the mainstay in meeting the general indication, since it relieves the organism of the depressing drag of a constant irritation, whether painful or not, and permits the patient to pass much of the time in the open air. These two ele-

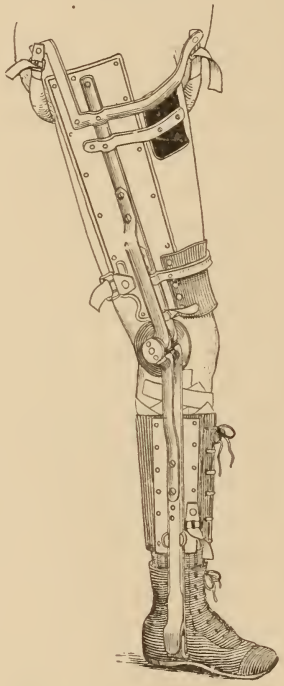
ments are powerful aids in stimulating appetite and cheerfulness, and in banishing sleeplessness and nervous irritability. One of the most gratifying results of proper mechanical treatment is the marked and speedy gain in general health and vigor.

The local indications for treatment are to provide conditions favoring the process of repair at the site of disease, to prevent or correct deformity, and to restore, so far as possible, the functions of the joint. They vary according to the stage and grade of the disease and the special features presented, and are met by mechanically protecting the joint from pressure and internal and external traumatism, thus favoring a more normal local circulation; by gradual correction of the deformity, and later by the protected use of the muscles and joint. In the stage of irritation and disintegration, the local circulation is defective and local nutrition is impaired from distention or from articular pressure. The sore joint surfaces are jammed together by abnormal muscular spasm; this increases irritation and local necrosis, multiplies the evil effect of movement and jar, and is unfavorable to the healing process. The mechanical indication is to keep the joint surfaces from pressing and rubbing against each other, in order to allay muscular spasm and prevent injury. This is done by applying mechanical counter-extension and fixation to the joint, the patient being kept in bed until the acute symptoms subside. Rest in bed for a time is necessary where much irritation exists, but does not alone meet the local indications. Mechanical counter-extension must be added to relieve the pressure upon the tender joint surfaces. This counter-extension must be applied with precision in the lines of present deformity, or so near them as to be perfectly comfortable. Indeed, if pain is present and rest is disturbed, these symptoms are regularly and promptly relieved by proper counter-extension; the relief from pain is often instantaneous, as in the following case:

A young man who had been in such pain for months from an exacerbation of synovial inflammation that he had been kept under morphine, and his physician and friends had considered it impossible to move him, was finally brought to New York. Fixation alone had been of small avail, but he breathed a sigh of relief the moment the straps of the counter-extension apparatus were tightened; and he remained free from suffering from that time, with coincident subsidence of the inflammation.

The joint, then, must be put to rest in the strictest sense, until all irritation has disappeared, the patient's health has improved, and we have reason to believe that the healing process is inaugurated. The time spent in bed will be from four to eight weeks, but the splint is applied at once, and worn continuously day and night. When the patient is recumbent a weight of four to eight pounds is attached to the apparatus, which may be so contrived that most of the varying indications at different stages of the disease can be met and the joint controlled at the will of the operator.

Fig. 1.



The apparatus preferred by the writer consists essentially of the Dow's supporting splint, devised by Dr. C. Fayette Taylor, to which is added a snap-joint at the knee, and a steel circle for fixing or changing the angle of flexion (Fig. 1).

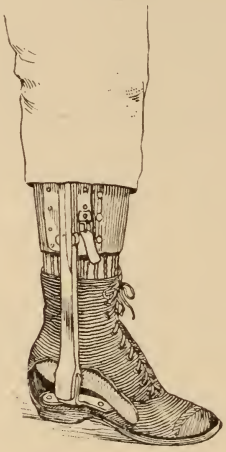
By means of the apparatus the knee is supported laterally, and fixed at the angle of choice, which must be such that no leverage is

exerted, and counter-extension is secured by a perineal strap and by adhesive plasters applied to the leg below the knee. A ratchet or screw extension is not required, as moderate force only is necessary for the knee—much less than for the hip, where the muscles are more powerful—and is obtained by traction on the strap attached to the plaster and secured by a buckle. The leg-bar of the apparatus must be rotated to nearly correspond with the eversion, so that no twisting force is exerted on the knee. If the fixation is in the proper position without leverage or torsion, and the traction is properly applied, muscular spasm will relax by degrees, and a corresponding correction should be made in the apparatus. The restoration of local conditions favorable to healing is one indication, and the correction of the deformity another, but the two should proceed coincidently. Allaying muscular spasm by constant traction with fixation and, when necessary, recumbency, permits a gradual and painless rectification of the deformity in a large number of cases, and as rectification of the deformity progresses, the mechanical conditions for counter-extension and fixation are more readily and perfectly fulfilled, and in many instances the joint is put into a condition more favorable for healing.

Many forms of apparatus are used to meet special indications, but the one we have found most generally useful and most readily adjusted to meet varying indications is the lock-joint, supporting and protective apparatus already mentioned. It is made of steel, properly lined with leather, and consists of two bars, ending in an accurate and substantial joint at the knee, which, however, is fixed by a spring during the first stage of the treatment. To the bars are riveted slightly concave steel thigh and leg plates, fitting accurately the external aspect of the limb. The lower bar, made of two overlapping pieces to allow of adjustment, reaches slightly below the foot, and is provided at the lower end with a slip-joint fitting into an L-shaped steel plate in the shoe, which may be applied and removed without disturbing the brace; the length of the brace is such that considerable space is left between the heel of the foot and the sole of the shoe. (Fig. 2.) To the leg-plate is riveted a leather legging which surrounds the leg, lacing up in front. At the upper end of the apparatus steel horns carry the perineal strap, an anterior thigh-plate keeps the apparatus from falling backward, and a knee-

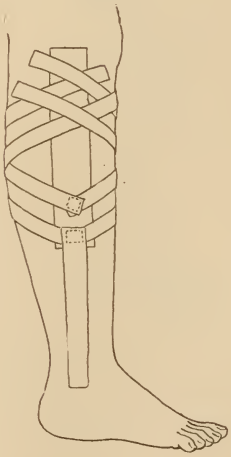
plate, carried by a curved, protected steel band, and fitted above the inner side of the knee, prevents lateral motion. A strap above the

Fig. 2.



popliteal space, and a buckle on the leg-plate to receive the adhesive plaster webbing, completes the apparatus, which should be made of

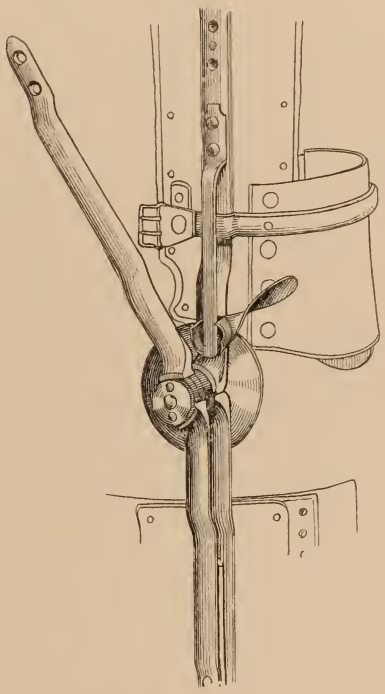
Fig. 3.



superior materials and workmanship to insure that perfect adaptation and solidity, which alone can give the comfort and instinctive confi-

dence necessary to successful management. A slight elasticity or "give" in the apparatus will set the irritated muscles on guard and check progress. A three- or five-tailed adhesive plaster[1] is applied to the outer side of the leg below the knee (Fig. 3) before the apparatus is put on. If the knee is sore and inflamed the patient will still lie in bed after the application of the apparatus, to insure perfect rest and absence from jar. When the patient can be moved comfortably with the brace, and inflammatory action seems to be regressive, he may be allowed to sit up or walk about on crutches, allowing

FIG. 4.



the affected limb to hang. When healing has progressed still further, the patient may walk between two crutches, and finally with a cane, taking the weight upon the perineal strap of the apparatus, which is "itself an ever-present crutch for the purpose of supporting

[1] "A Ready Method for Counter-extension at the Knee," by the writer; Boston Med. and Surg. Journ., Oct. 16, 1890.

the weight of the body during locomotion."[1] When so far advanced toward recovery that inflammation is absent, the knee may be slightly bent, when seated, by releasing the catch, which, owing to the peculiar construction of the release (Fig. 4), can easily be done through the clothing. Later still, the catch may be held open by inserting a rubber or wooden wedge beneath the spring, and the patient may be allowed to use the knee with motion, which may be confined within selected limits by placing steel stops on the joint disk, the delicate newly-healed joint structures being protected from friction and superincumbent weight and from lateral strain by the apparatus with its load-bearing perineal strap. Preparatory to discontinuing the use of the apparatus, the weight of the body may by degrees be allowed to rest upon the knee by lengthening the perineal strap and by shortening the leg-bar, so that the heel is allowed to approach or touch the sole of the shoe. It is believed that the gradual introduction of the muscles and joints to their natural function is not only safer than an abrupt change from fixation to walking without support, but that the prescribed, graduated use of the muscles and joint without harmful friction, in the absence of inflammation, is itself a remedial measure of high value in the recovering stage, through its effect in improving the circulation and nutrition of the parts, thus favoring their more perfect restoration.

Nothing could be further from the purpose of this paper than to advocate any particular form of apparatus as pre-eminently excellent in the treatment of osteitis of the knee; rather the intention has been to emphasize the varying indications presented by the disease in its different stages, which may be met in different ways once the principle of continued positive protection with the allaying of local irritation is recognized. The elements of protection vary with the different stages of the disease. The continued use of protective apparatus properly manipulated not only fulfils the local indication for enforced rest to the joint, but does so with a minimum of confinement, enabling the patient at an early stage of the treatment to move about and get an abundance of pure air, than which no general measure is more important. The knee is practically put to bed while the patient is up and moving about. "In a word, to be

1 "On the Mechanical Treatment of Synovitis of the Knee-joint," Dr. C. Fayette Taylor; New York Medical Journal, July, 1873.

master of the situation, and to be ready and able to respond to all indications, separately or at the same time, constitute the problem of the mechanical treatment "[1] of chronic disease of the knee-joint.

DISCUSSION.

Dr. Sherman said that the question of the injection of iodoform into the knee and other places seemed of great interest, but that he had used it with very little success. He did not know of any question which was of more interest to them than the question of avoiding an operation and curtailing the length of the period of mechanical treatment, by the use of some definite specific remedy. It was for that reason that he asked more especially about the use of iodoform, for he had found it more disappointing than otherwise.

Dr. Bradford said that the treatment he had adopted in all cases now was fixation, protection, and traction. Traction seemed of less importance in the knee than in the hip. Protection was furnished in his practice by the Thomas knee splint, or a modification of it; traction could be also furnished in that way, for operative measures can be performed in the knee more readily and thoroughly than at the hip. Erasion in children is to be preferred, when possible, to excision, as endangering less future growth of limb.

Dr. Shaffer said if there were any cases that required traction especially, it was at the knee-joint for tubercular osteitis. He thought the reason they did not always get good results was that their means of applying traction were limited. When they came to take into consideration the effects of hamstring, which makes an external rotation of the tibia, they found that they could not get a fixed point at which to apply their resistance. He would be opposed to any operation that would involve the loss of the two epiphyses, unless life or death depended upon the result. He had

[1] Loc. cit.

seen a great number of cases where there had been an arrest of growth of the tibia which had been very great between the years of seven and ten. He had seen many cases where relapses had occurred in the excision of the knee-joint, under what he would say was the best circumstances, even under the hands of our best surgeons. Whatever the operation might be, after an indefinite time, say perhaps three or four years, the patient was apt to develop a progressive inflammation of the knee-joint. In these cases the operation may have been incomplete. The treatment he had adopted after his experience with children, up to the age of fifteen years, was to apply traction in any direction which drew the head of the tibia forward and downward, maintaining it absolutely in that position for the required length of time. In younger children he sometimes used crutches, but after the age of adolescence is fairly reached he made much less use of this method. As a matter of experience, he would especially call attention to the adolescent period of knee-joint disease; he meant diseases which commenced when the child was seven or eight years of age, and which passed through the slow phases of adolescent life. His own experience led him to believe that those cases were not as amenable to simple orthopedic treatment as those cases were which occur and run through their course under ten years of age.

Dr. Ketch said that he thought the question of traction was a matter of importance in the treatment of knee-joint diseases, and he was suprised to hear Dr. Bradford make the statement that in his opinion, traction was of less importance in knee-joint diseases than in hip diseases. He was obliged to differ with Dr. Bradford in that regard, and incidentally also to a remark that Dr. Schaffer had made in regard to knee-joint diseases of adolescents. He believed that he made the point that the prognosis, as far as mechanical treatment was concerned, was very much worse in the adolescent than in the child. His criticism on Dr. Blanchard's apparatus, was that when they have deformity he would consider the apparatus inoperative. Dr. Hoadley corrects his position every three or four days, and that was a procedure which, in his opinion, he would consider very dangerous, especially as it was all hand traction and manipulation by means of the hand. His experience was, that with

a key traction it could be done much more accurately, much more effectively and safely, than where hand traction was employed. Of course, he was speaking of tubercular cases. He should consider it exceedingly dangerous to try to make repeated repositions of subluxations of tubercular knee-joint diseases.

Dr. Wilson said that he believed it was a mechanical impossibility to either obtain traction, flexion, or protection around the knee-joint by any splint which does not embrace not only the entire leg, but that does not have in addition some connection with the pelvis. He had been in doubt with reference to the methods of flexion, and he had performed a number of experiments. He had failed to get the results that he desired, and so he said that the limb in order to be fixed, must be in some way fastened to the pelvis. He had endeavored to reach the same end by the use of the Thomas splint or the Thomas principle.

Dr. Ridlon said that he would like to say one word in answer to what had been said. For many years he had used adhesive plaster for the sake of obtaining protection in knee-joint diseases. He had never been able to convince himself that he effected in that way any protection of the knee-joint. He thought possibly it mobilized the joint, but he did not think it gave any protection to the joint at all. He thought to get any protection to the joint, that you must make your counter-traction from the pelvis in the same way as done by the Thomas splint, by some sort of a ring or bandage. Then, by the adjustment of the adhesive plaster from the knee downward, he thought some traction could be gained. For the correction of deformity he used to believe in the slow and gradual correction which had been advocated to-day. At one time he believed, as Dr. Ketch had said, that it was the only safe way. He had once believed it was the only wise way, but he did not believe so any more, and his change of opinion was simply the result of clinical observation. Clinical observation had shown him that reparative action was hindered by the change of the angle of deformity. In other words, just so long as you are straining the leg, just so long you are checking, hindering, and preventing the healing process. Just so soon as you accomplish your changing of

the angle and your correction of the deformity and hold the leg in one position continuously, the healing then goes progressively forward. Therefore he believed that the sooner you correct your deformity, the sooner you begin the cure. The older the deformity, the greater the cause, and the greater the extent of tubercular inflammation was more vigorously had he attempted to cure the deformity. He proceeded to straighten the leg with his hand as far as he could straighten it, and then he immobilized it, and if it was not fully straightened he repeated the process as soon as the pain of the first effort ceased—in other words, within a few days. He again repeated the attempt until the leg was perfectly straight. He had yet to see the slightest harm from that procedure. He had not had any case that met with any relapse, and he had not had any case that resulted in tubercular meningitis or tuberculosis.

Dr. Griffith said that in his practice, in one case where they had attempted to correct a deformity of the knee-joint by the means suggested by Dr. Ridlon, where it had existed for quite a while, in attempting to extend the knee-joint they had ruptured the popliteal artery, and had quite a time trying to save their patient; so that this process is not unattended with danger.

Dr. Hoadley said, in answer to Dr. Shaffer, he would state that in the use of his instrument, the lower part of the foot did not travel proportionately faster than it ought to if he would take into consideration the fact that this joint is above the articulation and above the line of rotation of one upon the other. The tension applied by the hand was all that need be applied for corrective purposes.

Dr. Bradford said that he regarded forcible rectification as advisable in suitable cases. Dr. Goldthwait's modification of the appliance used before was an improvement. The results in Dr. Goldthwait's cases were surprisingly good. In these cases, although there had been some luxation for several years and right-angle deformity, Dr. Goldthwait succeeded in restoring the limb to a useful condition, permitting walking without crutch, cane, or apparatus, and with some motion.

Dr. Ketch said that he wanted to put himself distinctly on record here as being opposed to the rapid restoration of deformity in knee-joint cases in semi-acute and even in more chronic symptoms of tubercular disease. He had the good fortune to hear Dr. Goldthwait read the paper before the Medical Academy in New York, on the correction and cause of deformity of long-standing in knee-joint trouble. He agreed with Drs. Ridlon and Hoadley, that it does no harm to use forcible means of correction in cases where the tubercular process has been absolutely arrested.

Dr. Shaffer said that he wished to put himself on record as being positively and absolutely opposed to using anything like force in the treatment of tubercular knee-joint disease where there was anything at all that would suggest inflammatory symptoms. His convictions were founded upon experience and were very positive. He had seen a good deal of damage done by the surgeon, where he had been called in consultation to examine suspected joints.

Dr. Phelps said that he made a distinction between the suppurating joint and the tubercular joint; he made a distinction between the acute tubercular case and the chronic tubercular disease. In the case of the chronic tubercular disease, he had no hesitation in straightening the joint down, and he had to see the first case in which suppuration followed and in which there had been any marked increase of the disease. In many of these cases he found divided ligaments where dislocation had taken place. He was interested to know the difference between the treatment of tubercular diseases of the knee and tubercular diseases of the hip.

Dr. Bernard Bartow said that Dr. Willard had referred to a division of the hamstrings in the correction of deformity of the knee. He had been surprised to find the operation was little practised here, when it was by such simple means that the limb could be straightened without doing violence to the joint and the tissues about the joint without the bones becoming involved anew.

Dr. Willard said that on young children he did not think he would attempt this operation of forcible correction. He had

always protected these cases for a long time with a crutch or a cane. He believed it was a great mistake to allow them to walk around too soon. He thought it was better to keep the patients absolutely still for a long time, and then put them on crutches, and there would not be so much danger of relapse. He would be more fearful of causing a rupture of the popliteal artery by a pressure upon the posterior part of the tibia with screws and mechanism, than with the hand. He would much rather trust to his hands to apply the force, than to any instrument.

A CASE OF FRAGILITAS OSSIUM.

By WALLACE BLANCHARD, M.D.,
CHICAGO.

The case here reported is that of Miss J., aged twenty-seven years. At birth she was pronounced a healthy baby, but during her second month of life she suffered a fracture of the left femur at or near the neck, and demonstrated the brittleness of her osseous structure from that time on for twenty years with astonishing frequency.

I reported the case in 1875, at which time the mother's enumeration of fractures produced was as follows:

Right arm, 3; right forearm, 4; left forearm, 3; right thigh, 2; left thigh, 3; right leg, 14; left leg, 11; total, 40. To this I added a well-marked transverse fracture of the sternum between the fourth and fifth ribs, which, though the mother and daughter were at variance as to the date of its occurrence, had certainly existed for a long time.

This was the only fracture not occurring in the long bones of the limbs. As near as I can find up to the present time, there have been about seventy-two accidents, the left humerus escaping until she was eighteen years of age.

In most of the fractures of the forearm both the radius and ulna were broken simultaneously; in all the fractures of the legs that received attention the fibula gave way with the tibia, and so trivial a matter as the fracture of the fibula alone was hardly noticed. As nearly as I can judge a solution of the continuity in the long bones has been repeated in the limbs of this child at least one hundred and six times.

We had but a slight suggestion in these fractures of the laceration and contusion that come with the fracture of a healthy bone, as well as the inflammation and congestion that usually accompany it;

consequently this patient has suffered comparatively little pain. Undoubtedly only the want of muscular development has saved the girl from frequent fractures from muscular tension. The breaks have been about as transverse and the crepitus about the same as if the bones were pipe-stems. The force required to produce a fracture in this case could hardly be termed violence, the most trivial slip

or blow being sufficient. Her weight would break her legs, and so her life has been spent on pillows in a baby-carriage, but she is quite bright intellectually.

The process of union has been tedious in the extreme. On removing the dressings at about the seventh or eighth week the provisional bone uniting the fractured ends has had about the firmness of the rubber in the pencil-mark eraser in common use; and two or three years have been required to bring the union to any consider-

able firmness. Usually, however, the dressings have been removed at the second or third month, and the new union being of too pliable a material to resist the contracting power of the muscles, a gradual malposition has followed, reaching its greatest consummation a little more than a year from the time of fracture, and in the year or two following becoming comparatively firm in its vicious position. This has been repeated till the girl is in truly a pitiable state of deformity.

In each case the displacement has been of an angular variety, the callus being of sufficient strength at the time the splints were removed to keep the fractured ends of the bone approximated.

One might expect voluminous callus where there had been over a dozen fractures in the space of four or five inches, but such has not been the case. Unlike the cases of senile fragility that have come under my observation, the bones at all superficial points were perfectly smooth, and she had no premonitory pains. The muscles were fairly developed, except where they had become atrophied through want of use.

The girl menstruated first, though never but slightly, at the age of seventeen, and from that time on the fractures have diminished in frequency.

In the photograph the seeming shortness of the thighs is largely due to their being nearly on a plane parallel with the camera. The lines running from the figures 1 and 2 indicate the elbows, and those from 3 to 4 terminate at the lower edge of the patellæ. The distortions of the right forearm and thighs are not so well shown as those of the left forearm and legs.

DISCUSSION.

Dr. A. M. Phelps, of New York, said that in cases of this class there was no question as to the treatment. They should be put in plaster-of-Paris bandages, and to all exercise possible without injury to fractured limbs.

Dr. A. E. Hoadley, of Chicago, said that he would like to speak of a case of a similar character. Some twenty years ago there had been exhibited a case of this class by Professor Bond, of the

Chicago Medical College. He thought the child was then about twelve years of age, and it had suffered one hundred and nineteen fractures. In the earlier stages of the case there was a soft condition of the bones. The case had been reported in the journals. A feature of the case was the remarkable facility with which the bones knit, two weeks being ordinarily sufficient time for the bone to unite without any appreciable callus.

Dr. H. A. Wilson, of Philadelphia, said he had seen comparatively few cases, although he could recollect three of a similar nature. He was impressed by Dr. Phelps' remark, of an instance where the child was incased throughout with plaster-of-Paris. The legs were separated and the arms were separated; there were two fractures of the ribs. He thought there were three or four of the rib fractures on the right side. There was one fracture of the long bone when the child was three years of age. The child had died while under his hands from a fracture which had lacerated the abdominal aorta.

Dr. Shaffer said that the possibility of the condition should be borne in mind in treating club-foot, and reported a case of a child of about a year old in which, while endeavoring to overcome the resistance with a club-foot shoe, he had made a fracture of the tibia just above the ankle-joint.

Dr. Samuel Ketch said he would like to relate a case of this condition of fragilitas ossium that came under his observation some years ago, where the fractures often occurred simply on account of muscular movements, without the element of weight coming in at all. This was a case that he saw in a public clinic in New York. This child lying in bed, in turning would have a fracture, so that even a recumbent position was not always an absolute safeguard against fractures.

Dr. Blanchard, in closing the discussion, said that if the child referred to by him allowed her weight upon her limbs, it would break a bone. She had had frequent fractures from turning in bed; she had had fractures of the fibula and tibia several times. She had fractured her bones simply by dropping a teacup in her lap, from the weight of the blow; and in reaching out for anything she had fractured the tibia.

HISTORICAL NOTES ON THE QUESTION OF THE VALUE OF TRACTION IN THE TREATMENT OF HIP DISEASE.

By A. B. JUDSON, M.D.,
NEW YORK.

The treatment of hip disease has greatly changed in the last forty years. It can be still further improved, beyond a doubt, and to prepare for further advance we should keep well in mind the history of the past. As a slight contribution to such history the following summary or outline has been thought worthy of presentation.

The compilation from which the following extracts are taken was made previous to 1883. The reader will, therefore, not expect to find references to the many and valuable contributions to the literature of the subject which have been made since that date. I regret my inability, for various reasons, to bring these notes up to the present time. Neither can I claim that they are complete for the period which they cover. They are complete only so far as books and papers were readily accessible.

The manuscript compilation above referred to was made in the course of an inquiry as to which of the various opinions concerning traction expressed the correct explanation of its generally recognized good effects. The result of this inquiry—that is, the opinion which seemed to me correct—is noted in its appropriate place.

Incidentally, several points of interest came into view. For instance, the word *extension*, used to signify a drawing down or away, has given place to the less ambiguous word traction.[1] Again, we hear but little of late years of spontaneous dislocation as a feature of hip disease. It was formerly considered an extremely important

[1] See quotation from Dr. Yale, p. 117.

incident of the late stage, an opinion challenged by Dr. Alden March, who declared that "spontaneous dislocation of the hip (as purely the result of morbid action unaided by superadded violence) seldom or never takes place," adding that his convictions were "based upon actual observation and personal examination of about forty pathological museums in this country and in Europe."[1] Dr. George Hayward took the opposite side, saying: "It would require more specimens than would fill forty, or forty thousand, pathological museums to convince me that this [case related] was not a spontaneous dislocation of the femur."[2]

The merits of this rather nice question were presently lost in the interesting practical questions which arose when efficient and continuous traction became possible with the introduction of adhesive plaster as a means of grasping the limb. Traction then became useful, not to reduce dislocation, but to relieve pain and promote recovery. And with the beginning of what may be called the adhesive-plaster era, the effects of muscular contraction and measures for moderating or preventing them became the ruling subjects of observation, experiment, and discussion. In 1860 Dr. Davis published the first description[3] of the application of adhesive plaster for prehension and traction of the limb in hip disease, and thus excited interest in the subject to such a degree that in the following year the treatment of this affection was discussed in three successive stated meetings of the New York Academy of Medicine by Drs. Batchelder, Bauer, Bronson, Gordon Buck, H. G. Davis, Finnell, Holcombe, Krackowizer, Minor, Willard Parker, Post, Raphael, Sayre, A. H. Stevens, John Watson, and James R. Wood.[4] And four years later a not less important discussion on hip disease, in which the new treatment found its advocates and opponents, was carried through many sessions of the Surgical Society of Paris, by MM. Blot, Boinet, Bouvier, Broca, Depaul, Dolbeau, Follin, Giraldès, Guersant, Hervez de Chégoin, Le Fort, Marjolin, Trélat, Velpeau, and Verneuil.[5]

In these discussions, and in contemporaneous and subsequent writings on the subject, it is evident that muscular contraction

[1] Transactions of the American Medical Association, 1853, pp. 479, 480.
[2] Surgical Reports, Boston, 1855, p. 77.
[3] American Medical Monthly, April, 1860, pp. 262, 263.
[4] American Medical Times, April 17, May 4, 11, 25, June 15, 1861.
[5] Bull. de la Soc. de Chir. de Paris, 1865.

was receiving unwonted attention. On the one hand, the muscles appeared to threaten the joint, and, on the other hand, traction appeared to be the stout opponent of the muscles, and the result of the contest was the relief of pain. From these clinical premises, and too hastily, in all probability, the conclusion was drawn that muscular action was the chief pathological factor and that traction was the most important therapeutic agent.

Reflex muscular contraction in joint disease had long been recognized. John Hunter, in his lectures delivered in 1786 and 1787, said: "This stiffness of the joint depends on the involuntary contraction of the muscles, and is in consequence of the muscles sympathizing with the joint." "*Of muscles losing their action from injuries done to joints, tendons, and ligaments.* It is remarkable that an injury done to tendons, ligaments, fasciæ, etc., especially of the strain kind, impairs [*sic*] the muscles more than when the muscles themselves are injured, so that these muscles appear to sympathize with those parts of little motion, and become wasted and weakened in consequence. I think this arises from sympathy, or a consciousness of the parts being unable to answer to the action of the muscles, and it comes nearest to human reason of anything in the body. If the affection be temporary, as in common inflammation, the muscles do not waste, being conscious that the parts will recover."[1]

Reflex contractions were observed in hip disease by Guersant and Maisonneuve, and were considered by them as important guides to diagnosis.[2] Traction and counter-traction were applied to prevent their evil effects in the practice of Brodie,[3] 1834; Le Sauvage,[4] 1835; March,[5] 1853; Zannetti,[6] 1853; and Gustav Ross,[7] 1853.

[1] Lectures on the Principles of Surgery, Philadelphia edition, 1839, pp. 284, 290.

[2] "De la Coxalgie," Thèse de Paris, 1844, Maisonneuve, p. 106.

[3] See quotation on p. 95. [4] See quotation on pp. 104. [5] See quotation on p. 105.

[6] Bull. gén. de Thérapeutique, 1853 (from Gaz. Med. Toscana), pp. 136, 137; 1856, pp. 518–520. It is of interest to note that Zannetti applied an apparatus which secured extension and at the same time permitted the patient to walk without putting the weight of his body on the foot of the affected limb. And Bonnet's Traité de Thérapeutique des Maladies Articulaires, Paris, 1853, pp. 416, 417, contains the description of a portative splint, invented by M. Ferdinand Martin, which has two perineal straps, with joints at the knee and ankle, and provision for traction, abduction, adduction, and rotation.

[7] See quotation, p. 108. Other surgeons applied traction and counter-traction in hip disease, but without intending especially to combat muscular action: Ducros, Gaz. des Hôpitaux, June 3, 1835, p. 311; William Harris, Med. Examiner, Philadelphia, January 19, 1839, pp. 37–40; Bonnet, Traité des Maladies des Articulations, Lyons, 1845, vol. ii. pp. 322–324.

But these observations and experiments attracted no particular attention until Dr. Davis made traction by adhesive plaster in the treatment of hip disease. This material had been used in the last century to control muscular action after rupture or division of the tendo Achillis and fracture of the patella,[1] and Dr. S. D. Gross made traction by adhesive plaster in fractures of the leg in 1830.[2] But this method of treating fractures was not generally appreciated until Dr. Josiah Crosby advocated it in 1850.[3] One of his patients described the sensation of traction thus applied in these words: "It feels as if my leg was in the mud and I was trying to pull it out."[4] The words were homely, but they heralded, in common phrase a happy emancipation from the pain and disappointment which had ever been the lot of patient and surgeon when traction was applied by bandage, fillet, or laced gaiter.

This simple and successful mode of prehension of the limb was first used in the treatment of diseases of the joints by Dr. Henry G. Davis,[5] an honorary member of our Association, who named his treatment the American method,[6] a name which has sufficient warrant in the fact that the distinguishing feature of the method is the

They used the apparatus in vogue at the time for the treatment of fracture of the femur. Indeed, Bonnet's *grand appareil* had been described by him six years earlier as an apparatus invented for the treatment of fracture of the femur. Gazette Méd. de Paris, September 14, 1839, pp. 579, 580. In the same way the apparatus of M. Martin was prescribed in 1850 for fracture of the femur and in 1865 for hip disease. L'Union Médicale, December, 1850. De la Coxalgie, Paris, 1865, pp. 488–496. He sought to avoid the difficulty of making prehension of the limb by making traction on the posterior surface of the leg flexed at right angles on the thigh. Mr. Ford compared hip disease without an external opening to a simple fracture of the bone (Diseases of the Hip-joint, Edward Ford, London, 1810, second edition, pp. 132, 133), and Brodie carried the comparison further, saying: "If it [the cartilage] be extensively destroyed without suppuration, the case may be compared to one of simple fracture, and if there be suppuration, it may be compared to one of compound fracture" (Clinical Lectures, 1846, Boston edition, p. 287), a statement which drew from Alden March this apt inquiry: "If there be some analogy between the condition of the hip-joint in morbus coxarius and fracture of the neck of the bone, why should there not be some similarity in the mode of treatment?" Transactions of the American Medical Association, 1853, p. 503. This question of Dr. March is more practical than it was forty years ago, before the use of adhesive plaster had made traction so easy. And in this connection it is interesting to note that fractures of the lower extremity are being treated by the use of portative apparatus resembling the hip splint. American Medico-Surgical Bulletin, November, 1893 pp. 114, 115.

[1] Medical and Chirurgical Observations. By Benj. Gooch, London, 1773, pp. 108–110.

[2] The Anatomy, Physiology, and Diseases of the Bones and Joints. Philadelphia, 1830, p. 50.

[3] Transactions of the American Medical Association, 1850, pp. 382, 383.

[4] New Hampshire Journal of Medicine, October, 1850, p. 65.

[5] Conservative Surgery, New York, 1867, pp. 213, 214.

[6] "The American Method of Treating Joint Diseases and Deformities." Transactions of the American Medical Association, 1863, pp. 139–170.

application of traction by the use of adhesive plaster, a device which had its origin in this country.

The immediate and earnest advocacy by Drs. Davis, Sayre, and Fayette Taylor, of this method of treating hip disease at once opened a new field of clinical observation and experiment, which has been under industrious and ingenious cultivation ever since. A short and very incomplete list of the questions concerning traction which have been raised and answered in different ways includes the following: The question of fixation, the question of separating the articular surfaces, the question of moderating the pressure between the articular surfaces by counteracting the muscles, the question of stretching the muscles until they are paralyzed, and the question of keeping them stretched while motion is made in the joint.

The following alphabetical arrangement of references is presented with the desire to facilitate an agreement among us as to the *modus operandi* of the method with which we have been credited.

Adams, William. "On the Treatment of Hip-joint Disease by Extension with Motion, as Practised by the American Surgeons, instead of Long-continued Rest and Immobility," *British Medical Journal*, January 5, 1878, p. 10: "The object of this paper is to direct attention to the recent advances which have been made in the treatment of hip disease by American surgeons. . . . The first principle is that of extension as a means of relieving the most acute pain in joint diseases. . . . The second principle is that of extension combined with motion. . . . The object of extension is not, as generally supposed, to separate articular surfaces, but to overcome reflex muscular contraction, and by relaxing the muscular rigidity to prevent undue pressure of inflamed surfaces. . . . The English idea has always been rest and immobility to the joint. The American idea, during the last ten years, has been extension with motion, *i. e.*, preserving motion in the joint while the pain is relieved by extension."

Agnew, D. Hayes. *The Principles and Practice of Surgery*, 1881, vol. ii. p. 183: "They [walking splints described] are all constructed on very much the same principle and with a view to permit motion in the joint without articular pressure or friction—an impossible task."

Andrews, Edmund. "New Instruments for the Treatment of Hip

Disease," *Chicago Medical Examiner*, December, 1860. Describes his splint applied to the inner side of the limb, with a sliding rod carrying a crutch-head and screw for extension. Adhesive straps are attached to either side of the leg. Page 274: "The screw is then turned up until the padded crutch-top rests firmly against the perineum, and the desired extension is accomplished. In this way the weight of the patient rests upon the instrument and the instrument upon the ground, without impairing the extension."

"Notes of Surgical Cases," *Chicago Medical Examiner*, June, 1861, p. 294: "These [splints to keep up extension] are used in all stages of the disease. In the early months of the attack, the extension takes away the pressure of the inflamed head of the femur in the joint, and allows it to recover. After an operation it is used to prevent too great shortening while the end of the femur is contracting a ligamentous adhesion to the sides of the pelvis."

"The New Splint for Hip Disease," *Chicago Medical Examiner*, August, 1861, p. 445: "Slight motion of the joint when it is firmly extended is of but little consequence."

"Improved Methods of Treatment in Joint and Spinal Diseases," *Chicago Medical Examiner*, September, 1863, p. 428: "The local treatment of hip disease in the first or inflammatory stage consists in the application of some suitable instrument by which the weight of the body and the tension of the muscles can be entirely taken off from the joint, so that the inflamed surfaces no longer press and rub against each other." Page 430: "In the use of this instrument [an extension splint applied on the inner side of the limb] the patient is soon conscious of great relief. Even little children discover in a few days that it greatly relieves their pain, and insist on keeping it on."

"Report on Surgery to the Illinois State Medical Society," *Chicago Medical Examiner*, October, 1864, p. 558: "A vast proportion of the spinal, hip, and knee diseases are readily cured by any good extending apparatus which draws sufficiently to take off all the pressure and friction of the inflamed parts."

ARMAND, JULES. "De l'Extension continué comme Traitement de la Coxalgie chez Enfants," *Thèse de Paris*, 1878, No. 38, p. 29: "Continued extension [by the American splints] separates the articular surfaces, or at least lessens the pressure." Page 69: "We

believe that continued extension is an immobilizing agent. The thigh is drawn down in its axis, the muscles are fatigued and overcome and rendered incapable of movement, and the pelvis is restrained from wide motion by the counter-extension."

Barwell, Richard. *A Treatise on Diseases of the Joints*, London, 1861, p. 261: "Under these circumstances [pain and tonic contraction of the muscles increasing] the proper plan of treatment is to fight against the irritation and to counteract the muscular contraction." Page 266: "To counteract such force [muscular contraction pressing one bone on another], I have invented a form of splint." Page 267: "Besides the mere power of straightening a bent joint (only a secondary use of the splint, and not that for which it was invented), the India-rubber spring counteracts that force which presses the bones too violently together, thereby producing the spasm, keeping up the irritation and the caries. I have seen the most violent pains yield gradually to this contractile force; it appears, by its unvarying, constant, and unyielding power, to tire out the muscles, to overcome their spasm, and to keep the joint surfaces, if not asunder, still not pressing together."

"Lectures on the Natural History and Treatment of Hip-joint Disease," *Lancet*, 1862, 1863; October 17, 1863, p. 441: "Perhaps you will tell me that I am arguing in a circle—that having asserted the muscular spasm to be due to inflammation, it is not logical to prove inflammation due to the spasm. True, this is a circle; but it is Nature's own, and not mine."

Diseases of Joints, second edition, 1881, p. 464: "To prevent this pressure [produced by muscular contraction], or at least to mitigate its effects, is the object of extension."

Bauer, Louis. "Some Observations on Hip-joint Disease and its Rational Treatment," *New York Journal of Medicine*, September, 1853, p. 173: "We possess in permanent extension [traction?] a sovereign remedy for overpowering muscular reflex action, and ultimately restoring the greatly distorted form."

Discussion in the New York Academy of Medicine, *American Medical Times*, May 4, 1861, p. 297: "The new instrument [combining motion with extension] was admirably adapted to control and alleviate progressive hip disease." May 25, 1861, p. 345: "It was not possible for the articular surfaces to be directly

separated by an extension so insignificant as that exercised by the splints."

Lectures on Orthopedic Surgery, New York, 1868, second edition, p. 282: "I have derived little or no benefit from extension *per se* in the treatment of progressive joint diseases. Whatever benefit I have derived from it at all is unquestionably due to its collateral effect upon fixing the affected articulation."

Blandin. M. Maisonneuve (*Annales de la Chirurgie Française et Etrangère*, 1844, pp. 191, 192), says that M. Blandin advocates and practices a combination of extension of the limb with continued traction, saying that it is "a wonderful thing to see how the pain, often extremely severe, of hip disease disappears as if by enchantment."

Boeckel, Eugéne. "Des Effets de la Coxalgie Infantile sur la Croissance Ultérieure du Membre," *Archives de Physiologie*, 1870, vol. iii. p. 558: "Continued extension is also a method of immobilization, and many surgeons still object to the latter on the ground that it produces ankylosis. But it is arthritis, not immobilization, that produces ankylosis."

"Des Applications de la Traction continué au Moyen de l'Appareil à Sparadrap," *Bulletin général de Thérapeutique*, 1875, vol. lxxxix. p. 449: "Continued traction by the American method consists in traction of the joint by a suspended weight through the intervention of adhesive plaster applied to the limb." Page 456: "The effect of continued traction in hip disease is first to relieve the pain, then to remove or lessen the pressure of the head of the femur in the acetabulum, and, finally, to reduce the deformity."

Bradford, Edward H. "The Treatment of Hip Disease," *Boston Medical and Surgical Journal*, November 11, 1880, pp. 465, 466: "It would seem, therefore, reasonable to infer [from experiments described in detail] that the relief given by extension in some cases of hip disease is due to the actual separation of the bones involved in the joint, and that this more frequently is not the fact in the early stages of the disease is probable, considering the anatomy of the joint. In these cases, however, the muscular force which in disease draws the femur upward, crowding the head against the acetabulum or forcing it above the normal position of the latter, is counteracted by thorough extension. It is to this, probably,

that the relief obtained by extension in the majority of cases is due. This relief is so marked that there can be no doubt of its efficacy as a means of treatment. It is also true that extension, provided the pelvis is steadied, can be made to give efficient fixation, but it is manifest from cases which are frequently met with that simple extension without any attempt to secure the pelvis gives great and immediate relief." Refers to experiments of Morosoff, König, Paschen, Schultze, Reyher, and Ranke, made to determine the effect of extension on separation of the head from the acetabulum, and on the degree of hydraulic intra-articular pressure.

Brodie, Benjamin. *Pathological and Surgical Observations on the Diseases of the Joints* (third London edition, 1834), Washington, 1834, p. 55: "At a later period when, in consequence of the extensive destruction of the articulation, the muscles begin to cause a shortening or retraction of the limb, I have found great advantage to arise from the constant application of a moderate extending force, operating in such a manner as to counteract the action of the muscles. For this purpose an upright piece of wood may be fixed to the foot of the bedstead opposite the diseased limb, having a pulley at the upper part. A bandage may be placed round the thigh above the condyles, with a cord attached to it, passing over a pulley, and supporting a small weight at its other extremity."

Clinical Lectures on Surgery, Philadelphia edition, 1846, p. 297, describes the same apparatus: "In this upright piece of wood there is a pulley, which pulley is just in line with the thigh bone. . . . A few ounces of lead or some copper penny pieces put into a basket are sufficient in the case of a child. . . . The patient suffers because the head or neck of the femur is leaving its own place, and getting into new parts which are not intended to have the rough bone in contact with them. . . . It is astonishing what comfort I have known this to give the patient in some instances."

Diseases of the Joints, fifth edition, London, 1850, p. 139, describes the same apparatus, a leather strap being substituted for the bandage above the condyles of the femur and "the pelvis being at the same time fixed by a strap to the middle or upper end of the bedstead." Page 140: "This in some instances seemed to relieve the pain, and I am inclined to think that it was useful otherwise by counteracting the muscles, which tended to draw the limb upward.

However, it almost always happened that something occurred to prevent the experiment being fully and fairly tried; and all that I can venture to say respecting it is that it may be worth while in certain cases to give this mode of treatment a further trial."[1]

Busch. Armand, on pages 74 and 75 of his thesis, states that Busch affirms the good effect of continued extension on the course of the disease, but believes it to be the result of an increase of hydraulic pressure in the capsule, in opposition to which Armand cites the experiments of König and his own.

Cooper, E. S. "Editorial," *San Francisco Medical Press*, July, 1861, p. 145: "Often have patients slept better the first night after its application [referring to his tin splint for extension] than they had done for months previously."

Davis, Henry G. "Deformities and their Remedy," *American Medical Monthly*, March, 1856, p. 212: "These artificial muscles answer another important part in wearying out the contracted muscles by their constant action, night and day, thus tending to elongate them." May, 1856, p. 329: "This same principle of treatment —viz., the separating of the diseased surfaces and removing from them all irritation from pressure—is equally applicable to disease of the hip-joint." Page 330: "This [rubber used as an extending power] will act steadily and gradually without any violence and with very little suffering in comparison with permanent fixtures. When contracted muscle is to be overcome, it steathily wearies it until it silently comes off conqueror."

"A Case of Pott's Disease, with Remarks," *American Medical Monthly*, November, 1859, p. 361: "In morbus coxarius we separate the diseased head of the femur from the acetabulum, thus leaving the parts in a condition to recover so far as pressure might have interfered. By this means we also get in both instances [Pott's disease and hip disease] passive motion without friction."

"On the Effect of Pressure upon Ulcerated Vertebræ and in Morbus Coxarius," *New York Journal of Medicine*, November, 1859, p. 418: "Extension was made upon the limb, and after the

[1] Sir Benjamin was very familiar with Scott's dressing of those days, which consisted of adhesive plaster applied so abundantly as to obstruct the motion of the hip. It would have been a happy thought to use the same material with his weight and pulley instead of the bandages and leather strap.

muscles had become wearied, so as to allow the head of the bone to come down upon the inferior portion of the acetabulum, the pain was relieved." Page 420: "I can but consider it highly beneficial to keep up motion of the joint, yet not allow friction upon the diseased surfaces."

"On the Mechanical Means Adopted in the Treatment of Morbus Coxarius," *American Medical Monthly*, April, 1860, pp. 263, 264: "The extension is first made at that angle with the body that I find the limb; as the tenderness of the joint subsides, the body should be gradually lowered until it is brought in a line with the limb; when this is effected the splint can be applied and the patient put upon crutches and permitted to exercise." Page 267: "It puts the diseased parts in the best position for their restoration with a perfect joint, as it relieves the pressure upon the head of the bone, while at the same time it admits of motion, which increases the recuperative energy of the parts, inasmuch as it increases vitality."

"On the Advantages of Elastic Extension in Morbus Coxarius," *American Medical Times*, September 1, 1860, p. 149: "When I speak of extension I do not apply the term to confining the limb in a given position, but to the process by which the soft parts are kept continuously upon the stretch, whether by means of a weight and pulley or some elastic material, the result of which process upon the muscular fibre is to weary it and put it at rest."

"On the Pathological Basis of the Treatment of Joint Diseases," *American Medical Monthly*, November, 1862, p. 323: "If handled a little roughly, all the muscles will be upon their guard." Page 336: "When extension is made by an elastic material the muscular fibre becomes wearied, the nervous influence is expended, and the bones come down until the extending power is exerted entirely upon the unyielding tissues. . . . An unremitting draft is kept up upon the muscles, and yet the limb is not fixed but that the muscles may contract and thereby exhaust their nervous influence, and ultimately rest like any muscle wearied from exercise."

"The American Method of Treating Joint Diseases and Deformities," *Transactions of the American Medical Association*, 1863, p. 150: "Pressure, mostly owing to muscular contraction, is the most active agent of destruction in the morbid process. . . . The essential parts of the apparatus are simply means of exerting an elastic, con-

tinually extending force on one side and a resisting counter-extending one on the other." Pages 154–156: "The joint becomes in a manner fixed . . . as a remedial measure. . . . It undoubtedly is to protect the surfaces of the joint (that come in contact in the natural movements of the limbs) when diseased from friction. . . . So far as this object can be accomplished by the muscles holding the joint motionless, they so act. Now, in effecting this immobility, are the muscles of the diseased joint relaxed, and therefore at rest, or are they in a semi-contracted state, and thus fix the joints by acting equally upon every side of it? . . . If it is true that the diseased joint is held in a fixed position by a certain rigidity of the muscles passing to or beyond it, an amount of pressure corresponding to the contractile force of the muscles, as then exerted, must be produced upon the articulating surfaces of the joint, . . . producing absorption, when not sufficient entirely to arrest the nutrition of the parts, and when going beyond this point, death, with exfoliation of the parts pressed upon."

Conservative Surgery, New York, 1867, pp. 85, 86: "After the lapse of an indefinite period from the receipt of severe injury to a joint, the muscles acting upon it sometimes pass into a state of fixed contraction, or may start into spasmodic action upon any effort being made to move the joint, either voluntarily or by the attendant. . . . This action of the muscles is not dependent upon any disease of their fibres or their nerves, but is simply a contraction for the purpose of preventing, instinctively as it were, motion in parts where motion is productive of pain. This constant contraction of muscles passing over a joint, thereby guarding with increased vigilance against motion, when all movements of the joint give pain, is the efficient cause of the destruction of the parts pressed upon or against each other, and should always be counteracted." Page 206: "When disease about a joint renders the movements of that joint painful, . . . the joint is always liable to be destroyed by uninterrupted pressure effected through the contraction of the muscles passing over it. They do this by preventing the parts pressed upon from receiving nourishment, in the same way as a bedsore is produced." Pages 209, 210: "The treatment of simple synovitis in its earlier stages by extension is as imperatively demanded as at any later period, and relieves the pain as effectually. . . . Continued elastic

extension is applicable not only to synovitis, but to all other diseases within the capsule; and not only these, but when parts about or in the vicinity of a joint are so painful as to compel the individual to hold the joint motionless, extension should be applied, for the reason that the pressure exerted by the muscles in holding the joint motionless will strangulate the nutrient vessels of the parts held in contact." Pages 212, 213: "In diseases of the joints we were the first to point out, as an always-present factor in the destruction, the existence of unremitting pressure, as effected by contraction of muscles passing over the joints, causing constant forcible opposition of the surfaces within the joint. . . . When this fact was fully established in our mind we were led to seek the best way of counteracting the contraction of the muscles, and soon came to the conclusion that a constantly acting force, however moderate, must eventually weary muscles by giving them no respite." Page 214: "The first splint, as well as all my modifications, admits of free motion at the diseased joint, but rigidly excludes all friction of the diseased surfaces within the joint upon each other. This we consider the essential element in the treatment of the disease under consideration, viz., motion without friction."

Gibney, V. P. *The Hip and Its Diseases*, New York, 1884, p. 324: "By far the surest method [of relieving pain] is fixation and traction. The weight and pulley sometimes act like a charm. The spasm is overcome, the limb is supported, and the child falls asleep without fear." Page 358: "The one practical idea, however, to which all these splints tend is immobilization or fixation, with the associated idea of motion if desirable." Pages 359, 360: Points that seem to be settled: "(1) Traction does not produce any appreciable separation of the head of the bone from the acetabulum. (2) It does induce fixation and prevents concussion. (3) It relaxes muscles by overcoming reflex spasm. (4) Fixation is considered of far more value than pure extension. (5) Traction to be efficacious must be in the line of the deformity."

Hennequin. "Quelques Considérations sur l'Extension continué et les Douleurs dans la Coxalgie," *Archives générales de Médecine*, December, 1868, p. 79: "Continued extension, having overcome muscular power, separates the articular surfaces and does away with pressure and pain." Page 80: Recognizes the vicious circle, in which

pain increases muscular action, which in turn produces more pain. Suggests the theory that the contracting muscles keep the femoral head turned in such a way that the less sensitive portions of its surface receive the pressure. Page 176: "The object of continued extension is to paralyze the action of the muscles." Pages 186, 187: A case of eighteen months' duration in a girl of eighteen years, with apparent shortening of ten centimetres, treated by continued extension. "Twenty-four hours had not passed before the pain disappeared, the pelvis descended laterally around the lumbar column, the swelling subsided, and a cheerful confidence succeeded depression."

HILDRETH. "Discussion in the Boston Society for Medical Observation," *Boston Medical and Surgical Journal*, April 26, 1877, p. 506: "Dr. Hildreth thought that not so much extension was required as rest; extension sufficient only to overcome the muscular contraction."

HOLMES, TIMOTHY. *Surgical Treatment of the Diseases of Infancy and Childhood*, London, 2d edition, 1869, p. 444: "The early symptoms of hip disease are in a great measure muscular, and can only be treated successfully by measures directed to the relief of muscular contraction, *i. e.*, by mechanical extension." Page 447: "The first indication of treatment is to place the parts at perfect rest, under the influence of sufficient extension to avoid the exacerbations induced by muscular spasm." Page 448: "I have found nothing to answer so well as the old plan of suspending a weight to the foot sufficient to overbalance the tension of the muscles. . . . The spasmodic pains will subside, and the child, freed from the irritation and the loss of sleep which they occasion, will rapidly recover the aspect and appetite of health. . . . The most convincing experiment, and one which I have frequently repeated, is, after the starting pains have subsided (which they do usually on the second or third day from the application of the weight), to leave it off, when they will almost infallibly recur on the second succeeding night, again to disappear on renewal of the treatment."

HUGMAN, WILLIAM C. *On Hip-joint Disease*, London, 2d edition, 1866. Pages 35–39 contain reference to the *Fifth Report of the Hamburg Hospital*, where treatment was "in the latter stages by keeping up a gradual extension, so as to overcome the spasmodic

action of the extensor muscles, which, according to the opinion of Drs. Fricke and Taudtmann, when dislocation had taken place, not only tends to increase the deformity by further shortening the limb, but also adds to the inflammatory condition of the part by friction of the head of the thigh bone upon the dorsum of the ilium."

HUTCHISON, JOSEPH C. *Contributions to Orthopedic Surgery*, New York, 1880, pp. 8, 9: "The object of extension is (1) to correct the malposition of the limb. . . . By means of extension we also (2) overcome the spasm and contraction of the muscles which, by reflex contraction, press together the inflamed articular surfaces, and constitute the chief cause of pain in joint inflammation; but I do not think it possible, by any amount of extension that can be applied, to separate the inflamed and swollen interior surfaces of the joint so as to relieve them from pressure and the consequent pain. What we do accomplish by extension is the relief of spasm and of muscular shortening; and to quiet the muscles is an important therapeutic axiom . . . motion without friction, a condition which . . . seems to me to be a mechanical absurdity. We might, with equal propriety, speak of sound without vibration of the air." Pages 18, 19: "To obtain extension of the limb no apparatus is required. Extension is made by the weight of the suspended limb [the patient being provided with crutches and a high sole on the well foot], which is equal to one-fifth of the whole weight of the body, and is greater than the weight usually employed for extension. This is quite sufficient to subdue the spasm of the muscles which crowd the head of the bone into the inflamed acetabulum, and is the chief cause of the pain which the patient experiences. . . . The extension not only relieves pain, but it corrects the malposition." Page 40: "The spasmodic contraction of the peri-articular muscles is overcome by the gentle, persuasive, and painless (physiological) extension made by the weight of the limb." Pages 19, 20: "This plan of treatment should be adopted . . . except in the comparatively rare form . . . attended with great constitutional disturbance and excruciating pain. . . . Until after the acute symptoms have subsided such cases should be treated in bed with the long splint and the weight and pulley."

"Discussion in the New York Academy of Medicine," *Medical Record*, May 1, 1880, p. 492: "He believed it to be impossible to

separate the head of the bone from the acetabulum by any mechanical appliance, and all an apparatus could do was to prevent the head of the bone from jamming up into the acetabulum, and thus prevent pain."

HYDE, J. N. "An Adaptation of the Plaster Jacket to the Splints for the Hip," *American Journal of the Medical Sciences*, July, 1877, p. 124: "It will be seen from the preceding description that the hip-splint, as thus modified [combination of plaster-of-Paris jacket and short traction splint], provides for extension and counter-extension, with free mobility, and without perineal pressure."

JUDSON, A. B. "A New Attachment to the Hip-splint," *Medical Record*, June 26, 1880, p. 738: "Fixation is undoubtedly one of the principal functions of the long hip-splint."

"Considerations Respecting the Mechanical Treatment of Hip Disease, with Especial Reference to the Value of Traction," *St. Louis Courier of Medicine*, May, 1881, p. 370: "The advantages derived from the traction exerted by the hip-splint are due solely to the fact that it secures fixation." Page 371: "It is not believed that the hip-splint secures absolute immobility, but fixation or a reasonable degree of immobility."

"Some Practical Inferences from the Pathology of Hip Disease," *New York Medical Journal*, July, 1882, p. 910: "In these cases [early stage] the articular surfaces directly exposed to pressure are free from erosion or ulceration, while the underlying spongy tissue of the bone is deeply implicated, and yet reflex muscular contraction is one of the earliest recognizable symptoms. So far as the incipiency of the disease is concerned, the recorded facts of pathology fail to sustain the importance of muscular action." Pages 10–15: "In the middle stage ulcerations first appear on the neck and not on the articular surface, and when the articular surface is marred its lesions are less severe than those of the underlying tissue—facts which show that the morbid action proceeds from within outward, from the interior of the bone toward its surface; whereas, if the muscular contraction were an important factor the reverse would be true. When the evidences of pressure are found they are seen in the altered shape of the head and neck of the femur, and are as readily referable to the pressure and concussion incident to standing and walking as to the pressure resulting from muscular contraction." Page 15: "In

this [the late] stage the signs of disease are never limited to the parts directly exposed to pressure, for all the surfaces of the upper extremity of the femur, and sometimes a portion of the shaft, are thoroughly diseased. If the action of the muscles is productive of mischief in this stage the unremitting and firm pressure which is thought to accompany reflex muscular action ought to produce effects much graver than those which are found." Page 16: "If the femur were, in fact, propelled by such a force instead of the recession of the upper edge of the acetabulum and the occasional perforation of its floor, we should have in every case, and soon after the accession of the disease, an abrupt invasion of the pelvic cavity by the decapitated femur."

"What is the Rationale of Traction and Counter-traction in the Treatment of Hip Disease?" *Medical Record*, May 12, 1883, p. 511: "There are great mechanical difficulties in the way of the practical application of this idea [traction with motion]. If traction and counter-traction are applied in the line of the thigh and trunk, it is difficult to conceive that the same amount of force can be maintained through all the variations of flexion, extension, adduction, and abduction. . . . The idea is that traction and counter-traction are curative because they deprive the muscles of their contractility. Muscular fibre may lose its contractility from rupture or degeneration, but that it surrenders this high endowment to the application of traction is, to say the least, extremely questionable. If an elastic force be used the muscles to which it is applied would probably increase in size and vigor from the exercise."

"The Fixative Power of Traction in the Treatment of Hip Disease," *Medical Record*, July 7, 1883, p. 2: "Take two rods of iron and form an eye in the end of each by bending its extremity into a small circle. When the rods are joined by these eyes they will together resemble two links detached from a surveyor's chain, and there will be wide and free mobility at the joint. Then tie the free end of one link to a staple and apply traction, by means of a weight and pulley, to the free end of the other. It is seen at once that the mobility which existed at the joint between the links is absent so long as the traction continues. . . . Or subject the two links to traction in a hip-splint, tying the free end of one to the perineal straps and that of the other to the leather straps which lead to the

foot-piece. The result of applying traction by the rack and pinion is fixation of a remarkably stable and indestructible kind." Page 4: "The fixation which this apparatus secures is of a peculiar quality. It may be compared to the condition found in some forms of paralysis, when a joint is said to resemble a leaden pipe, which may be bent with suitable force, but retains with sufficient firmness whatever position it may be placed in. This fractional degree of fixation is attended with sufficient arrest of motion to allay inflammation, encourage the reparative process, and afford relief from pain; and yet it is not so inflexible as to prevent the gradual correction of deformity in obedience to the unconscious efforts of the patient to place the limb in its most useful position, which is that of slight flexion with neither adduction nor abduction."

KNIGHT, JAMES. *Orthopedia*, New York, 1874, p. 263: "Nothing is more fallacious than to expect a cure to be made by a continued extension of the limb, as that of the weight and pulley, which continues to extend . . . to the impairment of the tone of the muscles. In our experience it is only palliative to pain, and not curative, but actually injurious as a treatment."

LE FORT. "Discussion in the Surgical Society of Paris," *Bulletin de la Soc. de Chirurgie*, March 8, 1865, p. 77: An indication urged by American surgeons is continued extension, "not to prevent spontaneous dislocation, but to promote cure of the disease, and especially to relieve the pain often so severe in the early stages." Le Fort's extension apparatus described by Philipeaux (*Traité de Thérapeutique de la Coxalgie*, pp. 418, 419) is designed to gradually reduce flexion, to diminish pressure of the head in the acetabulum and to permit locomotion and motion in the joint.

LE SAUVAGE. "Mémoire théorique et pratique sur les Luxations dites spontanées ou consécutives, et en particulier sur celle du Fémur," *Archives générales*, November, 1835, p. 280: "I believe that the use of the bandage for continued extension is not only to lengthen the limb, which is not necessary in every case, but also to prevent motion and pressure caused by muscular contraction."

LISTON, ROBERT. "Lectures on Diseases of the Bones and the Joints," *Lancet*, November 25, 1843, pp. 237, 238: "All this [the use of a weight and pulley] may amuse the patient's mind, perhaps,

but I do not think any good can come of it further than preventing motion."

MacNamara, C. *Lectures on Diseases of Bones and Joints*, London, 2d edition, 1881, p. 425: "There can be no question that spasm of the muscles in cases of this kind may be overcome by extension effected through a weight and pulley, a means of treatment which cannot be too highly recommended."

March, Alden. "On Coxalgia, or Hip Disease," *Trans. Amer. Med. Assoc.*, 1853, p. 499: "It is proposed now to show how extension and counter-extension . . . can be explained on pathological principles. . . . By the pressure of the muscles that act on the head of the bone and acetabulum, in addition to ulcerative absorption, we get progressive absorption, and hence the great destruction of the osseous parts of the joint. . . . Extension and counter-extension are used with a view to prevent undue pressure on the delicate and tender surfaces of the diseased bones."

Markoe, Thomas M. *A Treatise on Diseases of the Bones*, New York, 1872, p. 114: "There is a mode (weight and pulley) of securing rest to the limb . . . which is attended with the very great advantage of relieving the pressure of the joint surfaces against one another, produced by the tonic contraction of the muscles surrounding the joint."

Marsh, Howard. "On the Prejudicial Effect of Inter-articular Pressure in Joint Disease, and the Application of Continuous Extension, by Means of a Weight and Pulley, as a Remedy for this Condition," *St. Bartholomew's Hospital Reports*, 1866, p. 149: "When the child had become free from pain, which was usually the case in from three to eight days, I went during the night, while he was asleep, and raised the weight and lodged it in the bottom of the bed, thus setting the muscles free from restraint, and giving them liberty to contract. In a very few hours many of the children so treated became restless in their sleep, and presently awoke with the old pain, and screaming." "The influence of such pressure as that which muscular action produces on the surfaces of a diseased joint is in the highest degree prejudicial." Page 150: "Seeing how grave an influence is excited on the course of joint disease by the pressure and bruising which the articular surfaces inflict upon each other, both during any movement of the limb and during muscular

action, it is obviously of importance in treatment (1) to keep the surfaces at all times from contact, and (2) to control the muscles." Page 151: "The necessity of providing artificially for the relief from pressure in disease is obvious, when it is remembered that in the spontaneous course of events, not only is the pressure constant, but also that it is greatly increased in its amount by abnormal muscular action. Extension, by means of a weight, is well adapted for supplying this need. The second indication in the management of joint disease to which I have referred is to control irregular muscular action. As this abnormal action is due, as we learn from Mr. Hilton, to the inflamed condition of the joint, it may be expected to subside when the inflammation passes off. Until this is the case, however, it will be found that it is perfectly controlled by continuous extension. By this force the muscles are tired out, and are soon made to capitulate."

"Lectures on the Diagnosis and Treatment of Hip Disease in Children," *British Medical Journal*, July 28, 1877, p. 98: "As the muscles and other rigid structures yield, the limb will subside into its natural position until it is in full extension and parallel with its fellow. As this change goes on, you must gradually shift the pulley, so that it is kept still in the line of the long axis of the femur." Page 99: "The greatest amount to which the surface of the head of the femur can be separated from that of the acetabulum cannot be more than about the tenth of an inch. And it is very difficult to preserve efficient extension and counter-extension within this range; for the parts cannot be acted upon as if they were parallel metal plates to be adjusted by a screw; they must be controlled through the agency of perineal bands and strapping fixed upon the skin, and all these are apt to give when they are subjected to constant traction; and, if they yield, though it be but slightly, they soon, in the aggregate, lose this tenth of an inch of extension which they should maintain, and then the articular surfaces come again into firm contact. Besides, I may refer to what has seemed another difficulty. Both Dr. Sayre and Dr. Taylor allow their patients to move the thigh upon the trunk by bringing it toward flexion, and it has always appeared to me that if the perineal band be adjusted according to their direction, when the limb is extended, it will become loose when the limb is flexed."

Maylard, A. Ernest. "The Double Splint in Affections of the Hip," *Glasgow Medical Journal*, March, 1882, p. 162: "To obtain what is absolutely necessary for joint repair—perfect rest—movement must be checked, muscular action counteracted, and still further, any pressure of the inflamed surfaces upon each other prevented."

Monod, Charles. "De l'Extension continué dans le Traitement des Arthrites," *Arch. générale*, June, 1878, pp. 723–725: "Recall the painful contraction, the muscular rigidity of arthritis, the *vigilance musculaire*, protecting the joint from inadvertent disturbance, but entailing deformity and destruction. Evidently continued extension, especially if applied in the early stages, acts by combating the excited muscles. Challenging them to the contest, it deprives them of their power, and in this lies the great advantage of this method. . . . Traction, really continuous, must triumph over muscular resistance. If the traction is permanent and strong enough the muscle will, after resisting for a time, finally yield and fall into relaxation. . . . We recall these facts because those who are using this method do not seem to view them aright. Overlooking the real object and seeking to separate the articular surfaces, they are absorbed in increasing the amount of traction, instead of making it really continuous."

Parker, Willard. "Discussion in New York Academy of Medicine," *Amer. Med. Times*, May 11, 1861, p. 311: "The treatment of inflammation in the early stage is rest. We get our extension and counter-extension by the application of this splint, and thereby we accomplish everything in the joint. Our patient gets the air, but that joint is still at rest."

Philipeaux, R. *Traite de Thérapeutique de la Coxalgie*, Paris 1867, p. 261: "The so-called American method is the application of continued extension to arrest the progress of acute disease and to dissipate the severe pain so common in the early stage." Page 262: "They apply continued extension to remove all pressure on the articular surface by the weight and pulley at night and special apparatus in the daytime. This practice leads to the neglect of the great principle of immobilization, without which nothing can be done." Page 284: "Starting with the mistaken idea that the pain is due to pressure on the articular surfaces and that the shortening is due to

absorption of cartilage and deepening of the acetabulum, they apply continued extension to prevent pressure and avert deformity." Page 285: "After deformity is reduced immobility may be assured by continued extension in the absence of proper immobilizing apparatus."

ROBERTS, M. J. "Elastic Extension and Articular Motion as Therapeutic Agents in Chronic Joint Diseases," *Medical Gazette*, (New York), February 18, 1882, p. 74: "He believed that it was necessary in order to preserve the integrity of the joint and the part below it to keep up a certain amount of motion." "If motion without friction was to be obtained, the splint must keep up extension with no articular pressure, and allow for the lateral deviation. What was wanted was an instrument that would automatically lengthen as the limb shortened in flexion. Such an instrument he had devised."

The Hip and its Diseases. By V. P. Gibney, New York, 1884, p. 377: Dr. Roberts describes portions of his splint as "constructed with special reference to exerting continuous elastic linear traction [by India-rubber] upon the thigh." Page 379: "By continuously exerting elastic traction, it is further claimed, articular motion becomes possible without inter-articular pressure or friction."

"The Fundamental Principles of Mechanico-therapy in Hip Disease," *New York Medical Journal*, March 15, 1884, p. 294: "The combined use of efficient resilient support, firm tensile circumferential compression, and elastic linear traction, renders the patient more comfortable and more quickly subdues reflex spasm than the independent use of any one or two of these measures; and during the continuance of their conjoint use, articular motion can be made without the slightest discomfort to the patient." May 3, 1884, p. 490: Maintains "the feasibility of permitting articular motion at the hip, under the restrictions of efficient resilient support, firm tensile circumferential compression and elastic linear traction."

ROSS, GUSTAV. "Ueber ein neues Behandlungsprincip der Gelenkkrankheiten," *Deutsche Klinik*, March 4, 1854, pp. 96–99: Deformity is caused by reflex muscular action. Refers to his statement made in Blandin's clinic, Paris, 1845, that myotomy of biceps in the case of a diseased knee would have lessened caries because the pressure from muscles would have been lessened. In hip disease

muscular action prolongs inflammation, and treatment should consist in preventing the contraction of the whole muscular mass around the joint. Treats all cases of joint disease by extension by weights and pulleys. The pain lessens astonishingly.

SAYRE, L. A. *American Medical Monthly*, April, 1860, p. 298: "When left to itself, the rest which is so essential to the joint is procured by the firm muscular contraction which prevents the motion in the joint, and is so perfect as in many instances to assume the appearance of genuine bony ankylosis. But this constant muscular contraction exhausts the nervous system and induces hectic fever; gives the child nocturnal spasms of intense agony; prevents nutrition of the limb, which results in atrophy. We therefore resort to artificial means to produce this rest." "The great difficulty to be overcome in securing entire rest of the joint is the danger of producing bony ankylosis, resulting from the general inflammation of the surrounding structures, and sometimes great stiffness and partial ankylosis of the well joints. On the other hand, if we remove the instrument and commence passive motion, without keeping up extension, there is danger of reproducing the inflammation. I have, therefore, come to the conclusion that perfect rest, however essential it may be to an inflamed synovial membrane, is not only unnecessary to the ligaments (which in the earlier stages were not involved in the inflammation), but was positively physiologically wrong. As the eye needs the healthy stimulus of light, so does the ligament need the stimulus of motion. If, then, we can give motion to the ligaments of a joint, while at the same time we prevent muscular contraction, so as to remove pressure from the synovial membrane, we shall accomplish our object." Page 300: "The India-rubber, by the permanency of its contraction, will overcome the muscular rigidity."

"Report on Morbus Coxarius, or Hip Disease," *Trans. Amer. Med. Assoc.*, 1860, p. 475: "If the effusion be excessive, or the inflammation acute, you will have an apparent ankylosis, caused by muscular contraction, which is an involuntary act, produced by reflex action of the inflamed or irritated nerves, and is done for the purpose of keeping the joint perfectly still. It affords the natural indication for the surgeon by imitating this action, to accomplish the same result, of perfect rest to the inflamed synovial membrane. This we may do in a much more effectual manner, for at the same time we succeed

in relieving the other parts from a pressure which, if long continued, must cause, in the absorption of the cartilage and bone, the destruction of the joint. Motion, when not accompanied by extension, is much more painful than rest, even if accompanied by the pressure caused by the muscular contraction. Hence the patient, naturally choosing the least of two evils, obtains rest of the part by muscular rigidity, even at the expense of the absorption arising from the pressure."

"Objections to the Treatment of Morbus Coxarius in its Advanced Stages by Extension, unless preceded by Tenotomy," *Amer. Med. Times*, May 9, 1863, p. 219: "The object of extension in the inflammation of all joints is to relieve pressure from the inflamed synovial membrane and cartilage."

"On the Mechanical Treatment of Chronic Inflammation of the Joints of the Lower Extremities," *Trans. Amer. Med. Assoc.*, 1865, p. 379: "Chronic inflammation of any joint produces reflex contractions, causing deformity and severer pain by increasing pressure at the diseased surfaces, thus making extension and counter-extension a necessary part of the treatment."

Introductory Lecture, New York, 1868, p. 11: "I have been enabled to test the correctness of the now established principle of extending a contracted muscle by the constant application of an elastic force, moderately but persistently applied."

"Clinical Lecture on Fibrous Ankylosis," *Medical Record*, September 1, 1874, p. 449: "Extraordinary results can be obtained in the way of overcoming muscular rigidity by the application of a constant unremitting force. Under circumstances favoring the application of constant unremitting elastic force equally as favorable results can be obtained by paralyzing muscular power, thus overcoming deformities produced by it."

"On Ankylosis," *Transactions New York Academy of Medicine*, 1874, p. 27: "This contraction [produced by reflex irritation] not only aggravates the disease by causing undue pressure on the parts inflamed, but also distorts the limb in accordance with the action of the most powerful muscles involved, and the distortion can only be prevented by the proper application of an extending and counter-extending force during the treatment of the disease."

Lectures on Orthopedic Surgery, New York, 1876, p. 244: "This

pain, moreover, is self-perpetuating, for the irritation of the diseased joint causes the muscular contractions, and these in turn aggravate the inflammation." Pages 273, 274: "The most important of all the means to be employed [first stage], and the one upon which all prospect of success depends is rest of the joint and perfect freedom from pressure of the inflamed articular surfaces." Page 275: "Extension is employed [second stage] for the purpose of counteracting the morbid contraction of the muscles, and to relieve the pressure upon the articular surfaces of the joint, and is persisted in until the more prominent inflammatory symptoms have subsided." Page 278: "The object of such appliances is merely to [third stage] relieve the joint from pressure by permanently extending the morbidly contracted muscles, and at the same time securing its perfect mobility."

"Discussion in the Surgical Section of the British Medical Association," *British Medical Journal*, August 30, 1879, p. 317: "The first point to be attended to is the employment of extension and counter-extension carefully regulated so as to readily relieve the parts from pressure, as indicated by the comfort of the patient. The next great element is rest, as complete and perfect as can be given to the parts." Page 319: "The first principle was rest, as absolute and complete as it could be made, for the individual joint involved in the disease; and the next thing was to prevent the muscular contraction that would always take place whenever there was inflammation. There should be extension of the joint just such as would prevent pressure and no more; otherwise destructive changes would go on."

"Discussion in the Surgical Section of the New York Academy of Medicine," *Medical Record*, December 6, 1879, p. 544: "Constant muscular contraction kept up constant pressure of the diseased surfaces, one upon the other, absorption occurred, and, where it had extended sufficiently far, the acetabulum was perforated and the head, or rather the upper extremity of the femur, rode through it. It was to overcome the constant and persistent action on the part of the muscles that some mechanical apparatus was employed which relieved them, and at the same time simply kept the diseased surfaces from coming in contact with each other." "By fulfilling these conditions [by extension and counter-extension] the exciting cause of the muscular contractions was removed, and with its removal went the

tendency to reflex muscular movements, and at the same time more or less motion in the joint was obtained."

"A Clinical Lecture," *Medical Bulletin* (Philadelphia), January, 1882, p. 4: "Where slight extension is made the movements of the joint can also be made, and thus permit of recovery without ankylosis."

"Discussion in the New York Academy of Medicine," *Medical Record*, May 1, 1880, p. 492: "Give the parts involved in the disease absolute rest and freedom from pressure without materially interfering with the mobility of the joint. Extension in such a manner as to permit motion should be the object sought for in any mechanical appliance, except in cases in which the inflammation is so violent that absolute rest is required for a time.

SCHEDE. Armand, on p. 42 of his thesis, gives a case from Schede of a girl of fourteen years, who had suffered the acute pain of hip disease for four weeks. For the six days before treatment the temperature was between 101.1° and 100.8° in the morning, and between 102.6° and 103.1 in the evening. Traction was applied, and after a night of sleep, the first in a long time, the thermometer recorded: The first morning, 99.5°; evening, 102.9°; the second morning, 100.4°; evening, 101.1°; the third morning, 99°; evening, 100°. From that time the temperature was normal.

SHAFFER, NEWTON M. "On Reflex Muscular Contraction and Atrophy in Joint Disease, with Remarks on Mechanical Extension," *Archives of Clinical Surgery*, June 15, 1877, p. 82: "The primary contraction that occurs in joint disease is reflex. Clinical experience proves that whatever relieves joint pressure and arrests motion will modify the contraction, and that whatever increases joint pressure aggravates the inflammation and intensifies the contraction. The primary indications are therefore to relieve joint pressure and to arrest motion. These can both be accomplished by a properly adjusted extension apparatus." "The extension is then exerted, so far as the conformation of the hip-joint will permit, directly upon the joint, and the contracted muscles yield as the cause of the contraction is modified."

"A Review," *Archives of Medicine*, October, 1880, pp. 198, 199: "When traction exists the patient has the advantage of that peculiar and perfect immobility which the extension of the long hip-splint

affords." "We made an experiment several years ago, which demonstrated beyond a doubt that the Taylor-Sayre instrument produces almost complete fixation in a healthy hip-joint. The experiment, in brief, was the application of a hip-splint to the right lower extremity of a child whose left hip was ankylosed from former disease. After the application of the splint to the healthy limb the patient could not walk one step. All motion at the left hip being lost, the boy, with extension, was unable to bring the flexible vertebral column to his aid. When the knee-cap was loosened and flexion of the thigh was permitted, the patient walked very awkwardly for a step or two."

STILLMAN, CHARLES F. "Extension and a New Method for its Production," *Medical Record*, December 4, 1880, pp. 620, 621: "The contractile force of the muscles is involuntarily excited to press the opposing articular surfaces still closer together. As a result of the increased irritation we have . . . injury to the articular surface, and, finally implication of surrounding tissues. Therefore, in order to overcome this primary irritation of the joint we must overcome the contractility of the muscles governing the joint."

TARBELL, G. G. "A Review," *Boston Med. and Surg. Journ.*, August 31, 1876, p. 263: "The patient is not to be confined as formerly to bed, but is to be furnished with such mechanical aid [portative traction splint] as will prevent motion of the joint, and slightly separate its inflamed surfaces." "Motion at the hip-joint [is] the very thing which in the acute inflammatory condition of the joint is acknowledged to be harmful, and to prevent which is the whole object of the apparatus."

TAYLOR, C. FAYETTE. "Improved Counter-extension Splint for Morbus Coxarius," *Amer. Med. Times*, July 20, 1861, p. 38: "The movement of every joint of the limb is most perfectly secured; that at the hip especially not being in the least interfered with by the counter-extension force."

"Some Considerations in regard to Hip-joint Disease," *Medical Record*, September 1, 1867, p. 290; "I do not believe it [the drawing out of the head of the bone] occurs or ought to occur, nor do I believe it would be anything but harmful if it did occur. The sole object of counter-extension is to destroy the tonicity of the muscles about the hip-joint. This destruction of tonicity gives relief and motion." "And this should be our aim, and until we have

accomplished it, we have not realized the benefit of counter-extension treatment at all. If a splint or weight be applied it may assist in keeping the limb steady and quiet, and in that way the patient may improve; but the improvement is due to the confinement and protection from motion, rather than to extension and motion, which latter are the two sources of benefit when counter-extension is efficient. I repeat the muscular tonicity must be temporarily destroyed. The counter-extension must be carried to that point. And we have a certain guide as to the amount of force to be used and the extent to which it is to be carried. When we have destroyed tonicity our chief labor is done. . . . If contractions accompany or follow the disease we may be sure that our counter-extension has been inefficient, and therefore worthless as such; and that the improvement, if any, is due to the quiet fixation of the joint, which the splint has been a convenient means of accomplishing. And I suspect this is very often the case in the use of both splint and pulley."

On the Mechanical Treatment of Disease of the Hip-joint, New York, 1873, p. 13: "On the very first intimation of a diminished ability to bear pressure, which is the great obstacle to a spontaneous arrest of any morbid process within the joint, the exigency of arresting motion to save the joint from immediate pain causes the muscles to take on a contraction of such a rigid and permanent character as to be a condition of perpetual wounding of the parts. Their own excessive action as well as their inelasticity constitutes a continued source of severest injury. Hence, there is established a self-continuing traumatic condition calculated to increase and prolong any diseased action once commenced in this joint; the more the disease the more the muscular contraction and rigidity to avoid motion, and the greater the pressure and injury to the affected tissues. . . . But add motion to a diseased and compressed joint and can we wonder at the destructive course disease of the hip-joint, ordinarily runs?" "It is pressure, or motion under pressure, which is the destructive agent." The first indication is "to relieve the pressure in the joint due to muscular contraction by temporarily destroying the muscular irritability and contractility." "The indication for arresting motion in the joint . . . pertains only to a condition of rigid muscular contraction, and consequent pressure in the joint. But no such necessity exists after the muscular rigidity

has been overcome to the degree of entirely removing all pressure within the joint. On the contrary, motion in the joint without pressure is not only not injudicious, but it is highly beneficial." Pages 25, 26: In regard to the first indication "I mean not only the increased muscular action which is incidental to the disease with the consequent increased pressure in the joint; but all muscular action, together with all pressure in the joint ought to be removed as the first step of any treatment which would carry out the principle of treatment of this disease by extension and counter-extension. A treatment which purports to be this, but which stops short of relieving all pressure in the joint by means of overcoming all muscular action, is not this treatment at all, but something else far different in principle. And here is where so many think they are adopting the treatment by extension, but, not carrying it far enough to destroy, temporarily at least, the irritability and contractility of the muscles, fail of success. Either through not conceiving that the legitimate object of antagonizing the muscles by counter-force is to entirely overcome them, or not having mechanical appliances capable of producing such a result, they must necessarily fail of realizing any of the advantages of this treatment. It is not enough to stretch the muscles, they must be stretched till they yield. And they must be kept stretched and relaxed till the disease in the joint subsides." Page 38: "I am speaking of a mechanical treatment of disease of the hip-joint which is capable of actually, not seemingly, overcoming—that is, temporarily destroying—the action of all muscles concerned in the movements of the thigh for the purpose of relieving all the pressure—not a part of it in the joint."

"On Some Elements of Diagnosis in the Different Stages of the Diseases of the Hip-joint," *Medical Record*, May 8, 1875, p. 318: "I follow one indication, viz.: to overcome completely the muscular action. I use the counter-extending force, not till the pain, if any exists, is relieved, but till the muscles relax."

"Observations on the Mechanical Treatment of Disease of the Hip-joint," *Boston Med. and Surg. Journ.*, March 6, 1879, p. 318: "The pressure from irritated muscles at this time is a much greater evil than motion alone could be. To overcome the injurious pressure from irritated muscles is, then, imperative. Hence we must stretch them." Page 319: "We must carry extension until the muscles relax,

and then we must maintain the extension until they lose their irritability and the inflammation in the joint has been given time to become retrogressive." "The limitation is reached at the point of time when the muscles have become soft and compressible, and the interstitial movements have become completely retrogressive. From this moment reflex irritation of the muscles ceases entirely, and with it the necessity for extension."

THOMAS, H. O. *Diseases of the Hip-, Knee-, and Ankle-Joints*, Liverpool, second edition, 1876, p. 10: "Continuity of extension, *per se*, is not a remedy in hip-joint disease, as I shall subsequently show; in its application it involves unavoidably a fractional degree of fixation which is sufficient to mask the evil of this ridiculous malpractice."

A Review of the Past and Present Treatment of Diseases of the Hip-, Knee-, and Ankle-Joints, Liverpool, 1878, p. 19; foot-note: "All forms of extension in joint disease involve inseparably in their application a certain amount of fixation."

VELPEAU. "Discussion in the Surgical Society of Paris," *Bulletin de la Soc. de Chir.*, 1865, p. 126: "For twenty years I have advised extension and counter-extension in my lectures and have used it in my practice. It is an excellent method of restraining the pressure of the articular surfaces."

VOLKMANN, R. "Distraction" was advocated by Volkmann in 1865 as a means of reducing pressure between the surfaces and relieving pain. Monod. *Arch. gén.*, 1878, pp. 706, 707.

WATSON, JOHN. "Discussion in the New York Academy of Medicine," *Amer. Med. Times*, May 11, 1861, p. 310: "I placed her [patient in acute stage of hip disease] upon the straight apparatus as if she had a fracture of the thigh. I had hardly put on the counter-extension before the girl was entirely free from pain. It operated beautifully and instantly."

WILLARD, DE FOREST. "Splint for Hip Injuries, Including Hip-joint Disease and Fractures of the Femoral Neck," *Philadelphia Medical Times*, November 6, 1880, p. 72: "All hip disease splints do good only by fixation."

WOOD, JOHN. "On the Employment of Double Extension in Cases of Diseases and Injuries of the Spine and Pelvic Joints," *British Medical Journal*, June 5, 1880, p. 837: "By extension

the pressure on the joint surfaces produced by the tonic contraction of the muscles is relieved or almost entirely prevented."

Wyeth, John A. "Hip-Joint Disease Successfully Treated by a Combination of Sayre's Long Extension Splint and Hutchison's Elevated Shoe and Crutch," *The Medical Gazette* (New York), April 17, 1880, p. 243: "Extension is made by means of the screw key until there is freedom from pain and a comfortable fixation of the limb." . . . "I do not think that anything will secure the uninterrupted fixation and extension of the joint so well as the long splint, in connection with the complete suspension of the leg."

Yale, L. M. "Certain General Considerations Respecting the Mechanical Treatment of Chronic Diseases of the Joints, with Especial Reference to the Use of Traction," *Medical Record*, January 12, 1878, p. 27: "When the muscular spasm is urgent, fixation cannot be secured, save by the use of a force as constantly acting as that which is to be overcome, and the agent best adapted to this purpose is traction, or, as it is generally called, extension. The word extension is objectionable because of its obscurity, since it is also used as the opposite of flexion." "The relief gained is not, as was formerly supposed by some, from separation of diseased surfaces. This separation is scarcely possible under any amount of force likely to be employed by a surgeon; and again, it is very probable that whatever separation could be accomplished has already resulted from the effusion within the joint. The relief is gained simply from the prevention of muscular contractions which violently grind together the inflamed and perhaps eroded surfaces. The aim of the surgeon should then be, not to use all the traction that can be tolerated, but to use the smallest amount that will insure rest of the articulation." . . . "Then, when the relief of the pain allows the muscles to relax, the direction of the traction may be changed."

SOME OF THE USES OF CONTINUED EXTENSION.

By HENRY G. DAVIS, M.D.,
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In your list of subjects of papers to be read before the convention, the uses of extension is prominent. As *continued* extension was introduced by me some fifty years since and repeatedly brought to the notice of the profession, and its various application given in a paper read before a medical society in New York City, I will state these uses again for this convention. I first used extension for diseased joints. By using it for this purpose, I found that all of the tissues could be elongated to any extent desirable; that what we considered bony union of diseased joints was only a shortening of all the soft parts around the joint, and could be overcome by continued extension. This extension does not stretch the parts, but excites nutrition, and thus adds to their length.

This result enables the surgeon to reduce dislocations of long standing. By employing this method I have reduced luxation of the hip of ten years' standing, without pain or inconvenience. It has also enabled me to give full motion to a hip-joint that was supposed to be ankylosed for seventeen years.

This extension is applicable to the treatment of fractures, and should be the *only* treatment of fracture of the neck of the femur, as it brings the parts into their natural position and retains them in contact, so that when union has taken place the position of the limb is natural.

Extension is applicable in restoring many deformities, in elongating the true skin until it will supply the place of the cicatrix of a burn. It is also applicable to enlarging the chest, giving more space to the lungs. I also discovered that extension could be accomplished

as well when applied over the bellies of muscles as to parts into which they were inserted.

This fact affords us a ready and successful method of treating fractures of the patella; it brings the bone down to its place so that bony union can be secured in every case. By it I have brought the fractured portion down when it was drawn up two and a half inches and secured perfect bony union. This with no other treatment than simple extension. A bandage may be applied around the knee so as to hold the parts in contact to facilitate their perfect union.

Again, I have brought the head up to its natural position when it was lying upon the shoulder, and the arms paralyzed from ulceration of the cervical vertebræ, restoring motion and position.

If continued extension is properly applied in ulcerated joints until the diseased bone has healed, the shortening of the soft parts will never occur and full motion will be secured.

In ulceration of any joints of the leg I devised splints and modes of keeping up the extension while the patient could still take out-of-door exercise.

Allow me to state that fifty years ago there was nothing in use to guide or aid the surgeon, but everything had to be originated, a task that will be difficult to fully realize at the present time.

THE QUESTION OF EXCISION OF THE HIP-JOINT FOR TUBERCULAR DISEASE, AND THE RESULTS OF THE OPERATION.

By HARRY M. SHERMAN, M.D.,
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In presenting the following table of cases I do not intend to discuss the whole question of resection of the hip-joint for tubercular disease. Almost every member of this Association has publicly expressed his opinion as to what constitute the indications for or against the operation. The table is left to such place in the statistics of the operation as it may merit. I shall add a few comments and explain briefly the opinions which have grown out of my work and observation.

In the last eight years, comprising the time of my residence in San Francisco, I have seen 146 cases of hip-joint disease in the active stages. These have been seen in hospital, polyclinic, and private practice. Of these, 40 have passed from observation, either untreated or after having been a very short time under my care. Of the remaining 106 cases, 42 have been treated in accordance with classical methods; that is, systematic protection of the joint by traction and rest in bed; or traction and immobilization by the ordinary forms of traction splints, the patient being up and walking on his splint, or walking on crutches; or traction and immobilization in a splint which held the patient from below the arms down to below the foot.

Of these 42 cases 7 have made perfect recoveries—that is, have recovered with no shortening and with no practical impairment of joint function; 10 have made imperfect recoveries—that is, there has been shortening and impairment, more or less decided, of practical joint function; 4 have died of tuberculosis of other organs; and 21 are still under treatment.

In the other 64 cases I have thought it best to excise the joint. Of these 64 cases 32 have been traced since recovering from the operation and leaving my immediate care, and their condition forms the substance of the table I submit. Six it has not been possible to trace, and their condition is unknown; 13 are dead, and of these, 2 died from the shock of the operation; 1 died of chloroform narcosis during a secondary minor operation; 2 died of tubercular meningitis, one soon after and one some months after the operation; 7 died of general tuberculosis, 4 soon after and 3 some time after the operation; and 1 died of pulmonary tuberculosis something more than a year after the operation; and, finally, 13 cases are still under treatment.

In four of these cases there has been disease of both hips, and both have been excised; so that there have been 68 operations on 64 cases.

As regards the method of operation, I have made, almost invariably, the Langenbeck incision; the exceptions have been in favor of Sayre's incision. The effort has been made in each case to remove every particle of tubercular tissue that could be seen and reached, though, of course, that ideal has probably never been absolutely attained, and in some cases it has been known that, in this particular the operation has been incomplete; during the operation and immediately after the wound has been douched and washed and scrubbed with a solution made of equal parts each of corrosive sublimate and pure hydrochloric acid in 3000 parts of water; the dressing has been by packing the wound, in every detail of its surface and recesses, with iodoform gauze, and repeating this packing every two, three, or four days, thus compelling the healing process to be by granulation from the bottom to the top; during this time the child has been kept in bed, light traction has been maintained by sandbag and pulley and plasters, other sandbags have been kept on either side of the limb to steady it, and the foot has been held by a foot-holder. After the wound has healed the traction has been removed and the child allowed to sit up in bed; in a week or so the child is taken up and dressed, and sat in chairs, or put on the floor to roll and creep. As soon as there is indication of desire to use the limbs this is encouraged and the child is taught to walk, no apparatus of any sort being used, and especially no lift or thick sole being put on to compensate

the shortening, for this would only add to the weight of the foot and embarrass the movements of the weak and unsteady limb. Later, when the child has learned to manage the hipless limb and the walk is free, the shortening is compensated by a light steel patten or a cork sole.

There is one exception to the statement of the non-use of apparatus. In some cases, and these have invariably been in the cases of older children, crutches have been used at the beginning of the post-operation walking, and, in the cases of some, even older children, the use of one crutch or a cane has continued to be a necessity.

The cicatrices have been such as the extent and character of the operation wounds and sinus openings would produce, but in the cases operated on early, before there had been much destruction of the soft tissues by suppuration, the operation wounds, though compelled to heal by granulation, have resulted in narrow linear cicatrices, which, in their later state, could be compared to the cicatrix of a first-intention healing.

I can, perhaps, best outline the indications for the operation by a little personal history. When I first took charge of the Orthopedic Service at the Children's Hospital, eight years ago, my inclination was to avoid all operations if possible; that is, no operation was undertaken if there seemed to be any chance of the child living, even if he carried always tubercular bone and discharging sinuses. The treatment was strictly conservative, especially in regard to the tubercular bone. After a year or so of this plan, and after seeing my operative cases get up and about and go home, while the cases that had not been submitted to operation remained in bed, or dragged around on splints, carrying their abscesses and sinuses, I began to question the value of my conservatism; and not only did I myself question it, but the parents of the children questioned it, and the longer I delayed in the hope that the abscesses and tubercular bone would be absorbed and replaced by healthy cicatrix, or that the suppurative process would gradually destroy the infected tissue, and that its detritus would all come away in the discharge from the sinuses, which would then heal, the more anxious did the parents become for me to operate. At this period I endeavored to follow a middle course; I did not delay too long before operating, but I gave each case that had abscess or sinuses a fair chance to escape operation, a

chance of four or six months, or a year, or even longer, and if in that time there was not decided improvement in every particular of local and general condition, I operated. Then the question arose as to the use of the delay—the ultimate result seemed inevitable, for even if the abscess did disappear, or the sinuses close, the tubercular bone was still *in situ*, and a number of the cases relapsed after going home, and were either returned to me frankly for operation, or were taken to some other surgeon for the same purpose.

It became very evident that the question of abscess and sinus was a secondary one; they were not the trouble; they were but symptoms; the lesion was in the bone—there was the focus of the local tuberculosis; if this process had gone so far that an abscess—no matter whether it was a pure tubercular, or a mixed tubercular and staphylococcus abscess—was the result, there was no point in any operative work that did not remove the focus in the bone, nor was there any point in any method of treatment that did not attain the same end.

By this time I began to see the later results in my earlier operative cases, and they were such that I felt encouraged to continue my operations and to operate sooner, until now it seems to me to be a proven proposition that: Given a child with tuberculosis of the hip and abscess, his chances for recovery and possession of a limb equally, if not more useful than can be attained by any other way, are all subserved by the earliest possible operation. The logic of this inevitably carries us one step further: Given a case of tuberculosis of the hip, but *no abscess*, in a child with feeble powers of resistance, and who is plainly staggering under his load of infection, that child's best chance for recovery lies in the resection of the tubercular bone. I am very well aware that bone tuberculosis is not, in the majority of cases, a primary infection, but no one can deny the benefit that may accrue by lessening the total amount of infection in a given case, and if this can be accomplished by the removal of a secondary focus, that removal is in order. If it is possible to go on further, and locate and remove the primary focus, its removal, too, is in order.

In comparing the results of the operative with those of the non-operative method of treatment, to learn which gives the most useful limb, it is proper to compare them with that class of non-operative results making an imperfect recovery—that is, with that class of

cases where the tubercular, or other infective process, has been of such intensity that bone and ligaments have been destroyed, their places taken by cicatricial tissue, and we get a shortened limb with limited range of joint motion. In such a case the normal mechanical relations of the parts are destroyed, and the work of the limb, both as a support to the body and as a means of progression, is correspondingly impaired.

Not submitted to operation.		*Submitted to operation.*	
Perfect recoveries	7	Traced	32
Imperfect recoveries	10	Not traced	6
Dead	4	Dead	13
Passed from observation	40	Under treatment	13—64
Under treatment	21—82		
Total number of cases	146		

Case.	Age at time of operation. Years.	Time from operation to examination. Years.	Shortening. Inches.	Extension. Degrees.	Flexion. Degrees.	Abduction. Degrees.	Progression.	Limp.	Atrophy of thigh. Inches.	Atrophy of calf. Inches.	
1	4	8	2¾	180	130	30	Nearly equal	Bad	2½	1	
2	7	7	2	160	90	0	Uses one crutch	.....	...	...	Neighbors report him to be in splendid health; able to walk and run like other boys.
3	4	6	1⅞	180	90	30	Nearly equal	None	⅞	¼	
4	8	5	1⅞	180	100	10	Equal	Medium	3¾	2¾	
5	3	5	...	...	...	...	.....	Slight	...	...	
6	16	5	...	145	90	...	Uses crutches	.....	2¾	2¼	
7	6	4½	1	180	120	45	Equal	Slight	1½	1½	
8	5¾	3¼	2½	180	130	30	Nearly equal	Bad	1½	1½	
9	17	3½	3½	180	130	25	Nearly equal	Slight	2½	1¼	
10	6¾	3½	1⅝	180	100	25	Nearly equal	Slight	1¼	⅜	
11	8	3	⅞	180	130	30	Nearly equal	Slight	0	0	
12	4	3	1⅛	180	145	60	Two-thirds step	Medium	½	¼	
13	4	2½	...	180	65	15	.....	.....	...	...	Right hip.
14	4½	2	...	180	60	26	.....	.....	...	...	Left hip.
15	15⅚	2⅙	3½	180	90	...	Uses cane	Bad	...	...	
16	10	2⅓	3¼	180	120	35	Equal	Slight	1	1⅛	
17	7	2⅙	1⅝	140	120	10	Two-thirds step	Bad	¼	¼	
18	13	2¼	1¾	180	135	28	Nearly equal	Medium	1⅞	½	
19	7	2	2¾	129	96	...	Two-thirds step	Medium	2¼	1¾	
20	15	2	3½	160	100	30	Nearly equal	Medium	4	3	
21	5⅙	1⅚	1	180	110	20	Uses one crutch	.....	⅜	⅝	
22	14	2⅓	3¾	180	130	35	Nearly equal	Slight	4½	⅞	
23	6	2	1¼	180	120	25	Nearly equal	Slight	1½	1½	
24	4	1⅔	1½	180	130	30	Equal	Slight	1	½	
25	4⅓	1⅔	1½	160	90	...	Just off crutches	.....	1¼	¼	
26	5¼	1½	1¼	180	150	25	Nearly equal	Slight	1	¾	
27	7	1⅔	2	180	120	30	Nearly equal	Slight	⅜	½	
28	8	1½	1¼	180	130	30	Equal	Slight	...	...	
29	4½	1½	1	180	100	10	Still on crutches	.....	1	⅝	
30	4½	1½	...	180	30	35	.....	.....	...	...	Left hip.
31	4¾	1¼	...	180	80	20	.....	.....	...	...	Right hip.
32	2⅚	1⅙	1⅛	180	120	35	Two-thirds step	Slight	1	¼	
33	8⅚	1⅙	2¼	180	103	48	Equal	Slight	1⅛	⅜	
34	10	1	2⅛	180	43	...	Nearly equal	Bad	¾	½	

Longest time from operation to examination	8	years.
Shortest time from operation to examination	1	year.
Average time from operation to examination	2⅚	years.

The average measurements of the ten imperfect recoveries in my non-operative cases are as follows:

Average shortening, 1.83 inches; average flexion (passive), 67°; average extension (passive), 145°; abduction (present in two cases only), slight; adduction, rigid (present in three cases), 10° to 22°; limb straight in five cases.

The average measurements of the thirty-four operative cases in the table are as follows:

Average shortening, 1.98 inches; greatest shortening, $3\frac{3}{4}$ inches; least shortening, $\frac{7}{8}$ of an inch; average flexion (passive), 112°; average extension (passive), 174°; in all but five cases the extension was full 180°; average abduction, 29°.

According to this, the average shortening is practically the same in the two sets of cases, and the operative cases have an average of 45° more flexion, an average of 29° more extension, and an average of over 20° more abduction.

In each of the ten imperfect non-operative cases progression on the affected limb is materially lessened, because of the limited joint extension; and there is a bad limp, because of the disturbed mechanical relations of the bones and muscles, and also because of the rigid condition of the joint with the limb not in its most advantageous position.

Of the operative cases in the table, 1 will always use crutches, 1 will shortly be off crutches, 2 will always use one crutch, and 1 is using a cane. These cases may, therefore, be considered as less satisfactory results. In the other 25, however, progression on the affected is equal to progression on the unaffected limb in 6 cases; is nearly equal to it in 13 cases; and is equal to two-thirds of it in 4 cases. Twelve limbs are not available for this measurement. The limp in the operated cases is described as bad in 5 cases, as medium in 5 cases, and as slight in 14 cases.

The case in which it is stated that there is no limp is undoubtedly mis-stated. Nine limbs are not available for this measurement. This means that the limb has been left, after the operation, in a position where it is under and can be a support to the body; that there is in the false joint enough possibility for active extension to accomplish satisfactory progression; and that there is enough motion in the direction of abduction, and enough control of that motion, to execute

the lateral sway from the hip necessary for the preservation of the equilibrium of the body in the absence of the hip-joint.

In every particular the advantage is with the operative cases, and while the comparison might give somewhat different results if a larger number of imperfect non-operative recoveries could be collated, I do not think the results would be changed in kind. In the present comparison I have used all the cases of that class about which I had the necessary information to make them available.

There is one more point to which reference is proper, and that is the shortening in the operative cases. The operation removes the epiphysis and more or less of the diaphysis. The growth of the femur is, consequently, lessened by just as much as it might have grown if the epiphyseal cartilage had continued its function, so that the shortening is progressive. But the shortening is the deformity of least moment, for it is so easily and perfectly compensated, and even if the compensation has to be gradually increased, in cases operated on in early life, until adult stature is attained, this is no detriment if the limb is, in other particulars, a useful one.

TRACTION IN HIP DISEASE.

By E. H. BRADFORD, M.D.,
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The question whether traction in hip disease is of therapeutic value or not, is presented for discussion in the following paper:

Although there is a general opinion that some advantages can be expected from traction, and in many places traction is employed, yet some deny that any benefit is to be expected from it, and a few regard it as positively injurious. The question clearly deserves careful investigation.

Pathological evidence is of the first importance in an inquiry of this sort, and pathological testimony is conclusive that in all chronic inflammatory processes at the hip-joint the head of the femur is crowded upward and backward toward the upper and posterior part of the acetabulum. This can be seen on examining every well-marked specimen of hip disease.

At the Warren Museum a dozen specimens of chronic diseases of the hip-joint were examined by Dr. Goldthwait and myself. In all of these there was evidence, from the absorption of the corresponding portions of the contiguous bone, as well as from the lines of limitation of the process of osteitis, that the head of the femur in hip disease is pressed against the acetabulum in a direction upward and backward.

This can be inferred clinically from the condition of the muscular spasm in hip disease and from the attitudes voluntarily assumed by the patients.

The amount of this intra-articular muscular pressure varies according to the extent of the muscular spasm dependent upon the strength of the muscle, and probably also of the amount of the inflammation.

It is clear that if a force in hip disease could be applied, counteracting the upward and backward pressure, it would be of therapeutic benefit—first, in relieving the amount of destruction of the bones from increased pressure; second, in checking the otherwise inevitable deformity following the natural cure of hip disease.

If any therapeutical measure can be clearly indicated by pathological data, certainly traction in hip disease is, if it can be shown that its efficient application is practicable.

To overcome the driving the head of the femur upward and backward, there should be a force in the opposite direction, sufficient not only to counteract the increased muscular spasm, but also to actually distract, that the inflamed bones may not be crowded together, and that cicatrization of the granulation and diseased tissues may take place uninterrupted by the friction and jar of contiguous portions of inflamed bone pressed together. The jar of superficial weight thrown upon an inflamed surface is also to be prevented, as well as the blow of the head of the femur, which is constantly driven into the acetabulum. Motion of the diseased surface under this undue pressure is to be made impossible.

Slight motion, if all intra-articular pressure were removed, would not be as injurious as the exaggerated constant articular pressure without motion.

An articular bone surface freed from pressure heals, as is seen in cases of amputation of the hip, where a carious acetabulum will be seen to cicatrize entirely.

These arguments would be accepted as beyond dispute. They have been presented ably by Davis, Taylor, Sayre, and others; but the bone of contention would be furnished when the statement is made that in hip disease a diminution in inter-articular pressure can be practically brought about by mechanical means, and to an extent which is not only appreciable, but also beneficial. This has been already proved clinically to the satisfaction of those who make thorough use of this method; but the arguments which have been brought forward in support of this statement are chiefly clinical—satisfactory to the advocates of the traction method of treatment, but not convincing or of service in argument. Statistics in chronic disease are not always conclusive to the bookmaker, for it is difficult to exclude all possibility of statistical error in a disease of so chronic

a character as one where the natural course requires several years before the pathological process is completed.

It will be readily admitted that traction will eventually overcome muscular spasm, and also that a traction of an amount of from ten to twenty pounds can be applied to a limb continuously, and for a sufficient length of time to accomplish a definite result.

There is need of proof, however, that the force distracts.

For the sake of brevity the question will not here be complicated by a discussion of the advantages of fixation in hip disease, but the inquiry will be limited to the simple query: Does traction distract? And if so, under what circumstances can distraction take place?

Experiments on the subject have been made by König,[1] who made frozen sections with and without a traction of eight pounds. A separation of from one-half to two and one-half was found to exist where traction is applied.

Paschen confirmed these investigations, but the results of the experiments of Morosoff did not agree.

Lannelongue found in the frozen section of the hip of a boy who had suffered from hip disease a separation of two mm. when traction of the weight of four kilogrammes was applied.[2]

Experiments have also been made by Brackett,[3] which showed conclusively that traction can distract. These experiments will be quoted briefly.

Brackett's Experiments.

"Experiments on cadavers of adults. Traction of twenty-five pounds (approximate). Change in the relation of the two bones taken by measurements from pins driven in pelvis and femur for the length, and the distance between trochanters measured for width. Integument intact. Measurements in millimetres:

[1] Zeitschrift f. Chirurgie, 1873, iii. 256.

[2] Lannelongue: Coxo-tuberculosis, Paris, 1886.

[3] Transactions of the American Orthopedic Association, vol. ii. p. 207.

TABLE I.

No.	Age.	Sex.	Angle of Neck of Femur.		Change in Width.	Change in Length.
1 (494)	40	F.	38		+ of 6	+ of 8
2 (484)	45	M.	34		+ of 4	+ of 3
3 (495)	56	F.	40		+ of 2	+ of 2
4 (486)	37	M.	19		+ of 4	+ of 2
5	17	F.	31	Right	+ of 5	+ of 5
				Left	+ of 8	+ of 8
6 (485)	72	M.	—		Not taken.	+ of 2

TABLE II.

"Subject: Cadaver of girl, three years old. Hip-splint applied; capsule exposed and opened by an incision parallel to fibres. Traction made in positions of extension, abduction 35°, and flexion and abduction both 35°:

Position.	Weight.	Result. Width.	Result. Length.
Extension	12 lbs.	+ of 0.5	+ of 2
"	18 lbs.	+ of 2	+ of 3.5
Abduction 35°	12 lbs.	+ of 0.5	+ of 2.5
" "	18 lbs.	+ of 1	+ of 3
Flexion and abduction	12 lbs.	+ of 2	+ of 1
" " "	18 lbs.	+ of 1.5	+ of 3

TABLE III.

"Subject same as in previous experiments. Left leg capsule exposed, but not opened; pelvis held in vise, and extension made from a fixed point:

Position.	Weight.	Result. Width.	Result. Length.
Extension	12 lbs.	0	+ of 2.5
"	24 lbs.	0	+ of 3.5
Abduction 30°	12 lbs.	0	+ of 1.5
" "	24 lbs.	+ of 1	+ of 2.5
Flexion 30°	12 lbs.	0	+ of 3.5
" "	23 lbs.	+ of 5	+ of 6.5
Flexion and abduction 30°	12 lbs.	+ of 1.5	+ of 4
" " " "	24 lbs.	+ of 1.5	+ of 5

TABLE IV.

"On the living subject. Hip disease:

No.	Age.	Weight.	Difference.	
			In length.	In width.
1	12	Right, 8 lbs.	+ of 3 mm.	+ of 3 mm.[1]
2	9	Right, 6 lbs.	+ of 8	0
		Left, 16 lbs.	+ of 8	+ of 3

TABLE V.

"Living subject. Hip disease:

No.	Age.	Sex.	Weight.	Result—Width.
1	5	F.	6 lbs.	+ of 2 mm.
2	—	M.	3 lbs.	+ of 1
3	8	M.	6 lbs.	+ of 1
4	7	F.	8 lbs.	+ of 2
5	5	M.	6 lbs.	+ of 2
6	6	M.	4 lbs.	+ of 2.5
7	6	M.	4 lbs.	+ of 1.5
8	7	M.	4 lbs.	+ of 2
9	6	M.	4 lbs.	0
10	5	F.	8 lbs.	+ of 1

"Table V. gives measurement of width at trochanters, with and without traction. Length not taken.

"The experiments in Tables IV. and V. were made on patients suffering from hip disease, the affected limb being observed."

Personal Experiments on Cadavera.

If a specimen of an adult hip-joint be examined—dissected so as to preserve the capsule and ligaments intact after removal of all other soft tissues—it will be seen that on horizontal traction distraction takes place.

This is evident without measurement, and clearly demonstrates that atmospheric pressure does not prevent distraction. Traction, however, if the limit is fully extended, does not distract, or if the limit is slightly abducted, corresponding to the normal axis of the trunk, distraction does not take place. If the limb is in a straight

[1 The presence of abduction probably accounts for the difference in the two sides more than the disease, which was on the right side.]

position in an adult hip, distraction is not in a horizontal direction, but obliquely.

The same thing is observed if the muscles and skin are not dissected off, but more force is required to cause distraction.

In a specimen of infantile hip-joint examined in the same way, it will be found that distraction is much more appreciable than in an adult joint, and much less force is required. Furthermore, distraction is not oblique, but in the direction of the axis of the trunk, if a horizontal pull is made with limb straight. This is to be expected from the shallow and undeveloped nature of the acetabulum.

A number of adult cadavera were taken in a dissecting-room in good condition and preservation, the limbs slightly flexed and abducted, and a strong pull, varying from fifty to sixty pounds, was made. It was found that the limb could be lengthened half an inch. The cadavera were the ordinary cadavera of the dissecting-room, prepared for dissection but not dissected. They were in good condition.

This experiment was repeated several times, and never without confirmatory results; demonstrating that in cadavera the head of the femur could be pulled away from the acetabulum.

The amount of force required is as follows:

A cadaver (negro of about forty years of age) was subjected to 55 kilos traction on the right leg, and distraction was evident. This was manifest from the increase of distance between the trochanters of $\frac{1}{2}\frac{1}{0}$ of an inch. On the left side traction of 25 kilos produced distraction, with widening of $\frac{9}{2}\frac{}{0}$; with 60 kilos, of $\frac{1}{2}\frac{5}{0}$ of an inch.

From these facts it is clear that in cadavera, when a force is applied sufficient to overcome the muscular resistance, distraction takes place, except when checked by the ilio-femoral ligament. When this is relaxed by putting the limb in a proper position, marked distraction can readily be made in cadavera.

Traction in Health.

Traction of 26 kilos was applied to the limb of a healthy male adult, forty-five years of age, and no evidence of distraction could be obtained, either in widening of the inter-trochanter distance or

in the increase in the lengthening of the limb. Traction was with the limb straight and but slightly abducted.

Traction of 10 pounds was applied to a child of five, who was thoroughly anæsthetized (ether being the anæsthetic), and no increase in the length or in the inter-trochanter distance was noticed. The traction was with the limb straight and but slightly abducted.

An infant of four months was etherized, and a pull of ten pounds was applied with the limb straight and but slightly abducted. Measurements were made and no lengthening could be detected.

Drs. Lovett, Cogswell, Dane, and Brackett, in a careful examination in an etherized child, found lengthening in a healthy hip-joint on the application of 20 pounds.

Traction in Disease.

Traction will be found to distract in cases of hip disease in the acute early stages, and also in the late stages where disorganization of the joint has taken place.

But in cases of hip disease, where what may be termed a convalescent stage or after cure has been reached, traction does not distract.

The following observations support these statements:

Adult, thirty-eight years of age. Hip disease, from which complete recovery was made ten years before. No distortion. But little motion in the hip-joint. Traction of 27 kilos, limb slightly abducted, caused no widening of trochanters.

Child of ten, in good health. Hip disease four years previous; at present in a convalescent stage, with slight flexion of the limb; slight motion at the joint; no muscular spasm. The trochanter lies a quarter of an inch above Nélaton's line. Traction of 10 pounds produced no effect on the widening of the trochanters.

Boy of ten. Hip disease of two years' duration, slight flexion, no motion at the joint, no subluxation. Traction of 15 pounds was applied. No widening in the distance between the trochanters was noticed.

Girl of eight and one-half years. Hip disease of one year's duration gave a similar result on being subjected to direct traction.

Boy of eight and one-half years. Hip disease of three years' duration gave the same result.

In these observations the measurements of the distance between the trochanters were made by means of a specially-constructed micrometer caliper, for which I am indebted to Dr. Higgins, of the City Hospital. This registers a variation of $\frac{1}{2000}$ of an inch, but the limit of error of observation, if care is used, is about $\frac{1}{40}$ of an inch.

In normal adult hip-joints no distraction can take place without widening of the intro-trochanteric distance. In young children this is not true, nor is it true if destructive disorganization of the acetabula or head of the femur has taken place. When widening takes place, however, on the use of traction, distraction is to be recorded.

A delicate child of five years, with a large amyloid liver, with hip disease of several years' duration, two sinuses, was etherized for the examination of the sinuses.

Treatment by traction had been carried out, and there was no subluxation. No incision was made, but the finger was introduced into the sinuses, which were dilated. The finger was passed so as to touch the head, and it was readily found that direct traction distracted. To determine the amount of force necessary for this distraction a spring balance was attached to the suspension straps, and it was found that appreciable separation was made if 10 pounds traction was applied. With traction of 6 pounds slight distraction was felt, but was not clearly manifested until 10 pounds was applied, regardless whether the limb was in a straight or fixed position.

On greater force being used the finger could be introduced and placed upon the acetabulum, which was covered with granulations. The head of the femur was partially absorbed. There was no sequestrum.

The writer has in several instances made the same observation in the course of the operation for excision of the hip-joint. After the incision had been made and the joint opened, the finger was placed upon the head of the femur and manual traction used. The head of the femur was in all cases easily pulled from the acetabulum.

On releasing the limb from the pull, the head returned to its normal position. This observation was made, it is needless to add, in cases of diseased hip-joint. This was done under an anæsthetic, and the resistant force compelling the head of the femur to return to its normal position was presumably of the ligaments.

A boy, five years of age, with tubercular disease of the hip-joint in a painful stage, and with night cries, was examined. The child had been in the hospital several weeks; disease had lasted several months. Measurements were made by Drs. Goldthwait, Selva, Cogswell, and myself, and repeated. No deformity was present, but limitation of motion and sensitiveness of the joint were present. The patient had been treated by traction for several weeks. Traction with 5 pounds, the limb in a straight direction (that is, in the direction of the axis of the trunk), gave lengthening of an eighth of an inch. Traction of 10 pounds, lengthening of a quarter of an inch. Traction of 15 pounds, lengthening of half an inch. No widening in the inter-trochanter distance noticed. Abducting the the limb 45 degrees traction caused lengthening of half an inch, but caused pain. Lateral traction of 9 pounds widened distance between trochanters one-seventh of an inch, and caused pain. Traction on well limb caused change of length.

A boy, three years of age, with hip disease of two months' duration. The case was not a severe one; there was no pain or tenderness. The boy had been treated by traction for a few weeks. The traction in the line of the axis of the trunk of 15 pounds weight was applied. No lengthening and no widening of the distance between the trochanters. There was no pain caused by this amount of traction. The limb was abducted to 45 degrees, and 15 pounds traction applied, lengthening of a quarter of an inch was found. Lateral traction of 15 pounds increased the distance between the trochanters a seventh of an inch; no pain in any traction.

A boy of eight, with hip disease of a few months' duration, and in an acute stage, with night cries, sensitiveness at joint in motion, was carefully examined as to widening of the inter-trochanter distance in traction.

It was found that direct traction of 15 pounds caused an increase of the inter-trochanter distance of three-twentieths of an inch on the right or affected side. On the well side traction caused no increase in this distance.

Lateral traction caused an increase of three-twentieths of an inch on the affected side and one-twentieth on the well side.

Direct and lateral traction on the affected side combined produced an increase in the inter-trochanter distance of six-twentieths of an inch.

Direct traction of 15 pounds was also found to distract in a girl of twelve years, with a sensitive hip-joint from hip disease of three months' duration; an increase of two-twentieths of an inch in the inter-trochanter distance being noticed.

The mechanical effect of traction is readily made clear if a hip-joint wound is examined and previously dissected, so as to remove everything but the capsule and the contiguous ligaments.

If the limb is slightly abducted and slightly flexed, traction distracts to a noticeable degree; if the limb is extended to its utmost limit, no amount of force distracts. The strong bands of the ilio-femoral ligament, one of the strongest in the body, resists; lateral traction is also checked if the limb is not everted slightly.

If the limb is adducted in a normal adult hip-joint, the head of the femur strikes on the lower rim of the pelvis.

The check in a dissected (but not opened) hip-joint is not atmospheric pressure, but the ligaments and capsule.

In a living patient the check first encountered is muscular resistance, which guards straining the ligaments.

It is impossible to estimate the strength of this muscular resistance in health or disease.

It is easy, however, to demonstrate the direction of the force of this muscular resistance.

On an os innominatum the attachments of all the muscles connected with the femur were marked, and small brass screw-staples screwed at intervals along the respective lines of muscular attachment.

Similar staples were screwed into the points of the femoral attachments of these muscles.

Slight rubber elastic bands were selected, of a strength no greater when stretched than the estimated muscular resistance of a normal muscle of the size of the gluteus medius when moderately contracted. One of these bands was attached to the staples representing each muscle, except that two were used for the psoas and iliacus, and only one (considerably stretched) for the group of the adductive muscles; none was used for the pyriformis or the gemelli. A balance was found to be established similar to the muscular balance, so that the limb remained in the normal position as it was placed; if, however, one of the bands was loosened, dislocation occurred. It was esti-

mated that this represented the conditions of the hip-joint of a normal adult, with all the muscles of the joint in a condition of moderate contraction.

It was found that 7 pounds were required to produce distraction if applied in a longitudinal direction, 6 in a lateral direction, and if 3 were applied laterally and 4 longitudinally, distraction was readily effected.

The existence of a force driving the head of the femur upward and backward was evident.

The conclusion from these facts is clearly that traction in hip disease, if properly applied, distracts, and that distraction can be made by a traction force feasible in practice; that no distraction takes place in a traction force of a few pounds.

As pathological evidence is conclusive that distraction, if possible, would be advantageous in treatment, it is impossible to avoid the inference that, in the treatment of hip disease in the active stages, distraction should be employed.

It is not the purpose of this paper to widen the discussion of the proper treatment of hip disease by considering the need of fixation of the joint—whether it is necessary or when it is necessary—or to investigate the respective value of different appliances.

The citation of cases or clinical experience is also not presented here, but a pathological specimen is here shown which would appear to demonstrate that hip disease of a severe type, attended by a suppuration, can, if treated by traction with care for years, be cured without subluxation, distortion, or enlargement of the acetabulum—a result not found in cases not treated or treated without thorough traction.

Patient, boy, aged nine years; died of tubercular meningitis, March, 1893, at the Children's Hospital.

Hip disease first recognized and treated in 1886. Treatment by recumbency and fixation, and later ambulatory with traction, and afterward with a protection splint. All apparatus discontinued in 1891. No motion of the hip-joint. No subluxation. Head of trochanter above Nélaton's line. An abscess had formed and been incised in 1888; sinus had discharged, but had healed entirely a year before death.

One-inch shortening of limb from arrest of growth of femur; position good.

At autopsy, no subluxation or widening of the acetabulum was found.

Complete cicatrization and entire absence of tubercular foci.

In conclusion it may be stated that from the evidence, both from experiments and from clinical facts, it would appear that traction in hip disease can be made to distract, and that it is needed in certain conditions of hip disease.

Traction at the Knee-joint.

The hip-and knee-joints are of an entirely different anatomical character, the hip being a typical ball-and-socket joint and the knee a hinge joint. Furthermore the muscular distribution differs largely. If the muscles that lie around the hip are contracted, the head of the femur is drawn upward, backward, and inward. If the muscles at the knee are contracted, the knee is flexed, and there is a force pulling at the head of the tibia backward, uncovering a portion of the lower surface of the femur.

Experiments on the cadaver in regard to traction at the knee show that there are checks to distraction at the knee-joint which do not exist at the hip. If the tibia is brought into the same line with the femur, no amount of pull can distract the tibia from the femur. This is due to the strength of the lateral ligaments and also probably to the crucial ligaments. If the knee is slightly flexed so as to relax the strong fibres of these ligaments, traction makes a noticeable distraction The same is true in the living, though more apparent in children than in adults.

The muscles are of but little influence in checking distraction. When the limb is straight, the anterior group of muscles is relaxed. When the limb is flexed this anterior group of muscles is in a state of tension—straightens the limb. The posterior muscles have a certain mechanical advantage, so they more than counteract the anterior group, and the tendency is to draw the head of the tibia backward.

Upon examination of a number of specimens of tubercular knee-joint disease at the Warren Museum, it is found that in every case subluxation takes place or tends to take place. The natural cure is one in which the tibia is drawn away from the lower surface of the

femur and allows cicatrization to take place when subluxation has been accomplished. Traction, when the limb is perfectly straight at the knee, does not distract unless the external lateral ligaments are weakened.

When the limb is slightly flexed and kept flexed, traction may distract—but fully as important as distraction is, for therapeutic purpose, the forward pressure of the head of the tibia, counteracting the spasms of the hamstring muscles, and preventing a disabling deformity.

In disease of the hip, the resulting deformity can be prevented by traction used with care.

In disease of the knee, traction alone straightens the limb and crowds the affected bone surfaces together, and does not directly prevent subluxation.

DISCUSSION.

Dr. H. A. Wilson, of Philadelphia, said, in regard to Dr. Sherman's paper on hip excision, that he felt very much impressed with the statistics Dr. Sherman had given and the paper explaining the cases, and they seemed to him to be presented in a thoroughly impartial manner, comparing cases that he has individually operated upon with cases that he has also seen and treated without operation. He thought the comparison was very fair, and at the same time more striking than similar figures that had often been presented to them. He thought that a surgeon studying the subject from a purely mechanical plan, would naturally select cases operated upon by the orthopedic surgeon or by the general surgeon that would illustrate his plan. These cases as a rule, he thought, were not as reliable as the figures given here. He had seen during the past winter some of the most disastrous limbs possible to conceive of as a result of surgical interference, where the mechanical factor was left out entirely. He recollected one case especially now, that has had an excision of at least four inches of the upper end of the femur, where there was present at this time twenty-seven sinuses extending from the middle lumbar region to the knee, every one of them in the

most active Vesuvius eruption. That could be taken as a case showing that surgical interference had been ignored too long. He therefore thought that Dr. Sherman's suggestion was a wise one. He thought the sooner that relief was had by the surgeon, the better. He thought if the surgeon could assist Nature in its progress, it was the wiser course. He thought Dr. Sherman's paper had presented the matter in a way that must strike everybody as the proper course. He thought the excision of a small amount of bone would be found often to be as much as would be required and leave the acetabulum unaffected. He found in certain cases that only the trochanter was affected, and in other cases the neck of the bone was involved, and the advocating of an early operation he thought was a strong point in the paper.

Dr. Hoadley said he would like to have Dr. Sherman express an opinion in regard to operating upon infants and children under two years of age.

Dr. Sherman said he would answer that in a paper to be read at a future time before the adjournment of the Association.

Dr. Phelps said that he wanted to congratulate Dr. Sherman on the presentation of a most excellent paper, and a paper they could always refer back to and find a fact that was worth something. He might not possibly agree with him in everything that he said, but he certainly did in the main. The question of when to operate in a case was a very important one, and the question of when not to operate was equally important. He was inclined to believe that the question when to operate must be left somewhat to the judgment of the surgeon. The rule that he had followed was, that in every case of hip-joint disease that came to him that developed abscesses under treatment, he operated on, not for the purpose of performing an excision, but for the purpose of evacuating the abscess, and then with his finger he could explore and intelligently determine the amount of disease present. When his finger had entered the area of the disease he could without harm to the patient determine whether an operation was demanded. He could wash out the joint and save his patient sometimes from excision. If, however, he found the acetabulum perforated, he invariably performed excision in that case, and removed the great trochanter so as to perfect drainage.

Dr. Bradford said that he wanted to add to what Dr. Phelps had said in complimenting the table which had been prepared by Dr. Sherman and the work which he had performed. The paper was an evidence that this Association was promoting the science of orthopedic surgery, and this, as far as he knew, was the best presentation of the subject of hip excision that had been made. He wanted to compliment Dr. Sherman and this Association on this paper. He said that criticism was hardly justifiable here; he only wanted to say a word, and that was of slight exception to the inferences from the figures presented. He thought the logical inference from these figures would be that early excision should be resorted to and that conservative treatment does not give as good results as operative treatment. This was hardly the conclusion which he and many surgeons would accept. He agreed with Dr. Phelps that every excision was a calamity, and that excision should be regarded as a last resort.

Dr. De Forest Willard, of Philadelphia, said that he was glad to see the excellent results obtained by Dr. Sherman. He said, given a thousand cases of those in the early stage of disease, when the patient could be under the care of a good orthopedic surgeon, he believed that the non-operative course would be the better one decidedly, and that the best results would be obtained, because the patient would be under good treatment from the beginning, and there would be no necessity for operation. But they had many cases come to them which were past that point long before they came into the hands of the surgeon. They must deal with these cases as they found them, and many of them would require operative procedure. In regard to statistics, with reference to operative work, he did not think they should include the best cases, as they would not give correct results. He thought that in ordinary cases, under good treatment, they could get excellent results without excision. There were a series of cases which required the most careful study and thought in regard to the plan of procedure. If the case was doing badly and there was the presence of undoubted suppuration, and tubercular disease was going on positively, he thought the surgeon should make an incision and discover the state of the bone. He believed that shortening the treatment would relieve the patient by removing the disease, but unfortunately the

great difficulty in hip-joint diseases was that it was not easy to determine if they had removed all the tubercular part. If he was certain in every case that he could remove all the tubercular disease, he would operate much more frequently than he did at present.

Dr. Shaffer said that it was his belief that operation and excision were not advisable more than perhaps in one of a hundred cases. He based his assertion upon a very anxious and careful study of the cases that had come under his observation. He thought it was a mistake to operate too quickly. He thought with properly applied traction and with proper apparatus and care, the operation of excision, and even the operation of opening the abscess may be avoided in, he would say, ninety-five cases out of a hundred. While he congratulated Dr. Sherman on the statistics of his paper, he did wish that the statistics had come to them based upon his personal observation of the cases. He said this without any reflection upon Dr. Sherman, who had stated that out of these cases there were no more than three or four the records of which he had been personally familiar with. They all knew how liable error was to come into these cases, and how conscientious they should be in making every measurement and in testing and watching the patient. It was a regret to him that every case had not passed under Dr. Sherman's observation before the report was submitted.

Dr. Ketch said that he thought that this matter was taking a wider range than they had originally started out with, as they had all had a chance to express their ideas on this some years ago at one of their meetings, and he did not see that there had been much change in the views of the Association. He would like to mention one case of excision that appeared to have been overlooked. He supposed that everyone in hospital practice, at least in New York, has cases that have been operated upon where so-called exsection had been performed. He had had several cases of exsection of the hip-joint that have had mechanical treatment that were now lying in bed with Dr. Taylor's hip splint on, and he was glad to say that they were all doing well. They came to him with marked deformity, with discharging sinuses, and had been placed under mechanical care, and were doing well. This class of cases, he

thought they would all admit, was by no means uncommon. He thought it had already been settled by Dr. Wright's paper, which goes over this subject very thoroughly, referring to the results of early operations by German surgeons in attempting to prevent a further invasion of tuberculous bacilli, that disastrous results had followed, as Dr. Phelps knows, and all of us know who have watched these cases. Dr. Gale has also given them some excellent tables of the result of excision in young children. He thought if Dr. Sherman, in connection with this subject, would give them a complete account of his own operative cases, with all the degrees of motion, atrophy, etc., that it would add very much to the value of the report. He wanted to congratulate Dr. Sherman on his able presentation of the operative side of the question.

Dr. Sherman said, in closing the debate, that if they would look over his table it would be found there were no statistics embracing children under two years of age. He thought there was no child that he had operated upon under two years except one, and that child died of tubercular meningitis. Before he went on any further he would say a few words as regards the advantages of a child's hospital in San Francisco—that the establishment of orthopedic service was found to supply a long-felt want. Before that, there was no end of cases divided around through the city and country, and when this service was established they came down upon him in great numbers for the first few years. He was not operating so often now, because there were not quite so many cases: He never refused a case because it was a very desperate one. Every case was always given its chance, and he believed it was better for the case to be put to the test and die than to be refused an operation because the result would likely spoil the statistics. They always had their chance to live and recover, and if they did not recover it was better for them and for the community. To come back again to the question of early operation, he could not say much from his early experience. He had observed that children three or four years of age, who had been operated upon, had gotten well more quickly and had been able to run around more nimbly than those who had been permitted to wait and who had been put to greater expense in attempting to limit the area of tubercular

disease for a long while. As regards Dr. Phelps' method of operating and his own, he would say that he very often hesitated before he began the operation of a case. He had sometimes begun an operation in great doubt, thinking perhaps he ought not to operate; but he had never turned away from the table without feeling that the operation was justifiable. It did not seem to him that it would be possible for those cases he had operated upon to recover under conservative treatment. He thought the cases that were operated on early were not so likely to relapse. If it is not possible to remove all of the diseased part, pathological process will progress. There were a certain number of his cases that had had a relapse, but those were cases where operation had been too long postponed.

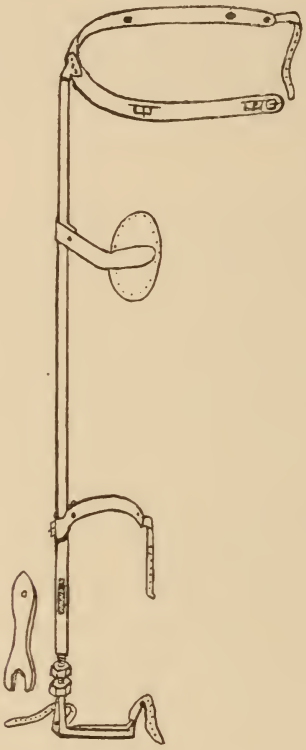
A MODIFICATION OF THE LONG TRACTION SPLINT FOR HIP DISEASE, DESIGNED TO PROVIDE A LIGHT APPARATUS FOR LITTLE CHILDREN.

By AUGUSTUS THORNDIKE, M.D.,
BOSTON.

It not infrequently happens in orthopedic practice that a little child, two, three, or four years old, has to wear a long traction splint, a high-soled boot on the well foot, and have crutches; and it is invariably slow work teaching small children to walk thus encumbered. In the out-patient department the parent is sure to become first discouraged, then firmly convinced that it is impossible for such a baby to walk on crutches, and in some instances the child is taken away from the clinic and all treatment for a while abandoned; if not then, after several months of encouragement and exhortation on the part of the orthopedist, the child learns to use its crutches, as it were, in spite of the unbelief at home. In the hospital ward instruction in the use of crutches is more easily and quickly given, but a little child monopolizes a great deal of the nurse's time and attention before it finally learns to walk, and it has seemed to me that much time and trouble could be saved by making the splint out of a lighter material than the square bar of iron or steel usually employed. For this purpose I have used for the upright of the splint a piece of steel tubing which is both lighter than iron gas-pipe and stiffer than brass tubing.

Into the upper end of the tube is brazed a forged piece shaped like the forging on the top of the upright of the Taylor hip splint, which serves to connect it by three strong iron rivets to the waistband. The waistband is not different from the one ordinarily used on long traction splints, and should provide buckles for two perineal

straps and the completing belt. Into the lower end of the tube slides an iron rod; the lower part of this is forged into a light foot-piece, while upon the upper portion for six inches is turned a thread of at least twelve turns to the inch, which carries two nuts; the first regulates traction by causing the extensible foot-piece to protrude from the tube, the second nut merely locks the first in position by "jamming." The rod should slide easily within the tube, and at



the same time almost fill it. By cutting a one-inch slot in the tube and inserting a small pin through the slot into the rod the foot-piece is kept from twisting. The bottom of the slot should be at least two inches above the lower end of the tube. Two leather straps riveted to the sides of the foot-piece serve to attach it to buckles on the leg extensions. The thigh-pad and posterior calf-band are secured to the splint by simply wrapping the end of the arm once around the

tube and tightening the screw. This holds firmly enough for a small child and does away with the necessity of making holes in the tubing, and therefore adds greatly to the strength of the splint, while it enables one to alter the position of these arms with great ease up and down on the upright. The upper part of the tubing may be made to fit the natural curves of the body, but the lower six inches should be straight, to allow the rod to slide within it.

In applying the splint the belt and perineal straps should first be tightened; the straps from the foot-piece should then be buckled firmly into the buckles on the webbing of the leg extensions, and the completing strap of the calf-band fastened. In putting the splint on, care should be exercised to have the pin at the top of the slot. By turning the upper nut with the wrench any desired amount of extension may be applied; then, holding the first nut steady with the wrench, the second is turned firmly down on to it; this locks both of them and prevents slipping. Two wrenches are provided to do this.

I have only had occasion to apply this form of splint twice during the past eighteen months; but the rapidity with which these little children have learned to get about led me to think that I have been using too heavy apparatus. My limited experience has already disclosed two facts about the splint: First, that any rivet-hole or screw-hole in the steel tube makes it liable to break; second, that the two nuts "locked" together will loosen if the little patient attempts to discard crutches and walk on the splint. Now that steel tubing is manufactured in this country the cost of these splints should not exceed that of the long traction splint with extensible foot-piece, bearing a ratchet and windlass for adjusting the extension.

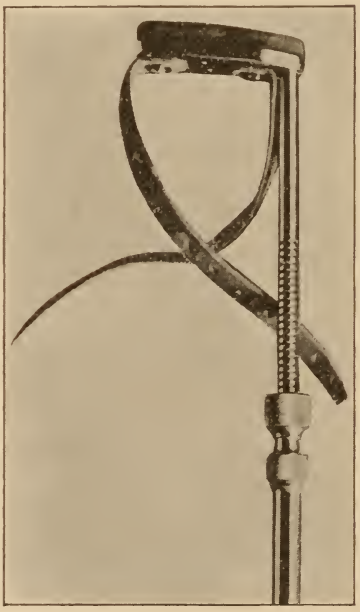
NOTE.—It is needless to say that the writer of this paper was not aware of the Davis tubular splint referred to by Dr. Newton M. Shaffer, nor of Dr. L. A. Weigel's new splint, otherwise due reference would have been made.

A NEW TRACTION MECHANISM FOR HIP SPLINTS.

By L. A. WEIGEL, M.D.,
ROCHESTER, N. Y.

The accompanying mechanism is presented for your consideration and criticism.

The special points in its favor are the ease with which it is manipulated, and the fact that it does not require the use of a key or



screwdriver for its adjustment, and, furthermore, that when traction is made it cannot be suddenly released by accident.

It consists of a coarse, square-thread screw which telescopes into

a shaft made of steel tubing. For the purpose of preventing the screw from rotating within this tube, a feather is brazed in, which works in a groove cut in the screw. Traction is obtained by running the screw out by turning a milled nut. When the desired amount of traction is obtained, this nut is firmly held in position by a lock-nut which prevents all possibility of the screw going back from its position by concussion in walking or other means.

When it is desired to secure fixation of the hip, a chest-band is conveniently added to the splint in the manner shown in the model. This supplementary piece is placed between the hip-band and the shaft, and is secured by means of two pins, which may be driven out whenever it is desired to allow motion at the hip.

I call your especial attention to the use of steel tubing for the construction of the entire shaft, which aids materially in reducing the weight of the brace and is sufficiently strong to bear any strain.

DISCUSSION.

Dr. Hoadley said he would like to ask Dr. Weigel if the inner tube was a rod or a steel tube.

Dr. Weigel said that his own appliance was a solid rod, very strong and very light.

Dr. Shaffer said that he had in his possession a splint made by Dr. Henry G. Davis himself, which was almost identical with that of Dr. Weigel's. He thought it well to place the fact on record at this time.

TREATMENT OF ABSCESSES.

By HENRY G. DAVIS, M.D.,
EVERETT, MASS.

I HAVE noticed in the papers upon joint diseases that have come under my observation a great degree of anxiety expressed as to the result of cases where a large abscess existed. I felt the same anxiety when the first case of the kind came to me for treatment. A mode of treatment was then adopted which I have found no reason to change.

After putting the patient under treatment by extension with pulley and weight until the tenderness was gone, the abscess was opened with a lancet, the contents discharged, aided at the last by *slight* pressure; then it was washed out several times with blood-warm water, using a syringe for the purpose. After all the flocculent matter was removed and the water returned clear I injected a French preparation of chlorine. This was allowed to remain a few minutes, and then gently pressed out; a tent was introduced to prevent the opening from closing; a compress was laid on the seat of the abscess and secured by a roller bandage. The object of the compress was to bring the walls in close contact so that they might unite. This union took place in every instance where this plan was followed and in no way interfered with. In one instance, when an old surgeon was present, without saying anything to me, he introduced his finger to see, as he said, how much the bone was diseased. Erysipelas followed in consequence, involving the whole limb. The patient, however, recovered.

If we could have a preparation made from the chloride of lime and prepared of the proper strength it would answer the same purpose. You may think me exaggerating when I state the fact that the walls of the abscess united in every case thus treated, the tent

keeping an opening for the slight discharge that followed. The thorough cleansing of the abscess by water enabled the preparation of chlorine to come in contact with the entire surface of the walls, thus preparing them to unite when brought together. This treatment is applicable to all abscesses which can be reached by it.

This has been my experience in every case since I introduced the treatment of diseases of the joints by continued extension, some fifty years since.

TREATMENT OF SLIGHT CASES OF KNOCK-KNEE.

By F. BEELY, M.D.,
BERLIN.

The treatment of severe cases of knock-knee requires energetic measures, and the surgeon must not hesitate to use them. A number of methods have proved successful, and among these he can make a choice. To these methods belong the forcible reduction of the deformity, followed by plaster-of-Paris bandages, osteoclasis, and osteotomy. All these means necessitate a long confinement to the bed, or at least fixation of the leg in an extended position for a certain length of time. Although they may produce a considerable amount of discomfort, the use of them is imperative. But it is another matter where the patients do not yet experience any inconvenience, where it is simply a question of arresting the growth of a deformity, of correcting a defective appearance.

The majority of the patients are boys from two to five years of age. Among 29 of my patients, 3 were two years old, 10 three, 13 four, 2 five, and only 1 ten years old. Among girls, knock-knee is not less frequent, but it is more seldom brought under treatment, as the dress conceals the defect. Almost all women are more or less knock-kneed. I have never in such cases been able to reconcile myself to the use of an apparatus which would immobilize the knee-joint and oblige the patient to walk for months with stiffly extended legs, for almost without exception the genu valgum is bilateral. I have always employed apparatus allowing of movement in the knee-joint.[1]

In spite of many trials and alterations I have not succeeded in finding a contrivance which has been satisfactory to me in every respect, although in nearly every case I have succeeded in diminish-

[1] One such is described in Centralblatt für Orthopäd. Chirurg., No. 6, 1884.

ing the deformity, or at least in arresting the process. The apparatus were either too complicated, heavy, or expensive; they required too great a sacrifice of time or money. Or, again, when of simpler construction, they were apt to shift their position on the limb, which made them useless. As far as my experience goes, a great number of the machines described in the text-books are open to this objection.

It is only within the last few years that I have obtained more satisfactory results by a line of treatment which I have been following exclusively for quite a time now, and which, therefore, I think I may recommend for trial to my colleagues. I wish to state, however, once more, that mine have all been *slight* cases of *bilateral* genu valgum, and in such alone should my proceeding be applied.

A simple method of measuring the degree of deformity, and later on perhaps of improvement, is to place the patient horizontally on his back on an even surface, the condyli interni of the femora just touching each other. While the legs are held in this position by one hand placed just above the patellæ, the distance of the malleoli interni from each other and from the point of contact of the condyles is measured. The two numbers thus obtained give the lengths of side of the isosceles triangle connecting the three points named, their proportion determines the degree of deformity. In cases under my treatment the distance from the knee to the ankle was 19.32 cm., and the greatest distance between the ankles 7 cm.

Before commencing the treatment of a case the surgeon must endeavor to ascertain the cause of the disease. It will be found to consist in over-fatigue in the case of children as well as of young people near the age of puberty, such as apprentices, waiters, etc.; the genu valgum infantum likewise owes its origin to this reason. Accurate inquiries often prove the exactness of this statement. The patients are nearly always children of the better class who are left to the care of servants, and who, according to the opinion of the parents, and sometimes of the family physician also, cannot have too much exercise in the open air, and must, once or twice daily, take a long walk. During this stay in the open air they are not allowed to run, stand, sit, or rest as they may choose. They

must follow the nurse, step by step, at a pace often too rapid for their powers, and, as a rule, they return home weary and exhausted. It not seldom happens when the maid is questioned, that the children are reported to be indolent, to have no desire or inclination to walk; and further, that they complain of pains in their legs after their daily exercise. Even at home they do not find the necessary rest; for many parents think that on reaching a certain age children no longer require the mid-day nap, and that they are fully able to sit up until night.

It is, therefore, essential that the physician should inquire into the mode of life of these children, into the way in which their out-of-door exercise is taken, and into the manner of their games and playthings. The latter should be selected in reference to the fatigue as well as to the enjoyment which they may occasion, many games and plays requiring too much standing on the part of the children. A certain portion of the day should also be reserved for rest in a recumbent position.

This is not always easy to accomplish. It is particularly difficult to make an old and *experienced* nurse understand the necessity of this daily rest. Healthy children are naturally so fond of exercise that it is unnecessary to urge them to take it; they instinctively fall into the movements requisite for their physical development; and when a child complains of languor and unwillingness to walk or play there is sure to be some reason for this condition, and it is the physician's business to find out what that reason is. Of course there are exceptions to this rule, particularly in the case of overfed children.

The modern houses, at least in Berlin, are so well constructed in regard to light and ventilation that it is hardly necessary to send the children out daily for many hours in the open air. In winter, particularly, short walks or drives will be sufficient.

The physician is frequently asked if gymnastics would not be of benefit to the children. Especially is this the case when older brothers or sisters take home instructions from a master in these exercises. I have forbidden gymnastics to older children suffering from knock-knee when these have formed a part of their school exercises. The children must stand at least one hour during the lesson. This is fatiguing, and therefore injurious to them. In

home gymnastics an exception can be made, as, during the pauses, the children can be allowed to sit or lie down.

In any case I do not believe that any great benefit is derived from the practice of gymnastics. The walking exercises, if they are carried out under the direction of a master who has been a drill sergeant, should be carefully watched; the everted position of the feet and the overstrained knees making them positively injurious. The physician often finds it difficult to convince such a master that children cannot be put through the same exercises as soldiers. In short, I never *recommend* gymnastics; I *allow* them under certain circumstances.

The gartering of the stockings should also be taken into consideration. The side elastics which are fastened to a belt must be discarded (Lücke); the elastic should be attached to the front of the stocking, or a circular garter should be worn above the knee.

The children's state of general health does not, as a rule, require intervention. I recommend, however, to strongly salt their food, especially when they show a fondness for salt (which sometimes goes so far as to lead them to eat salt pure). In such cases I also have them take salt baths from time to time, say once a week.

From these general directions we pass to the special mechanical treatment of knock-knee, the day treatment differing from that of the night.

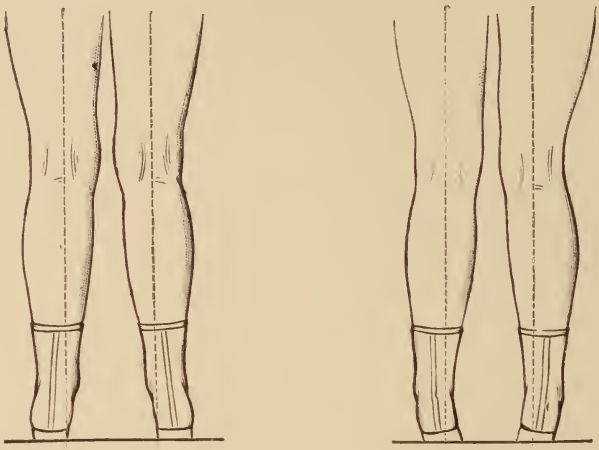
During the day the children should wear laced boots. The heels should be higher on their inner margin, about 0.5 cm., and their lower surface projecting inward, whereby they are brought nearer to the median line of the body. Through this means the calcaneus is adducted, and the base of the foot, as long as it rests on the ground, is nearer the median position and more directly underneath the centre of gravity of the leg. The statical relation will thus be improved (Fig. 1, *a* and *b*). The effect of this oblique heel is to reduce the prominence of the internal malleolus. The effect is less perceptible in the knee, but it is presumable that it exists there also.

This use of oblique heels is not new. Paré has recommended it. Still, judging from the majority of books on orthopedic surgery, it is at present rarely applied in Germany.

The shape of the sole must also claim attention. It often hap-

pens that knock-kneed children toe-in to a great extent. The surgeon, when consulted, recognizes knock-knee as the cause of this toeing-in. In this inverted position of the feet we perceive an instinctive effort to change the statical relations, in the same manner

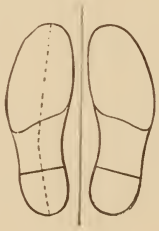
Fig. 1.



a *b*

that we produce this effect through the use of the oblique heel. Therefore children should not be prevented in these efforts. On the contrary we should encourage them by having the anterior part of the soles made to turn toward each other (Fig. 2). I need not

Fig. 2.

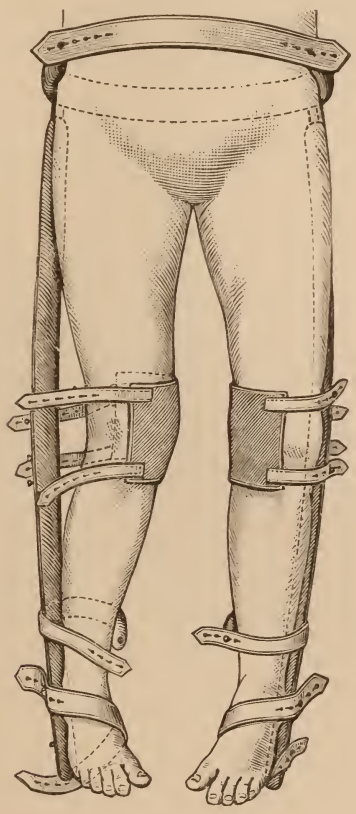


call attention to the fact that *all* toeing-in is not to be encouraged. It can be beneficial only when it is the consequence of abnormal conditions such as genu valgum, pes planus or pes valgus, which it serves to correct. It frequently happens that knock-kneed chil-

dren also suffer from pes planus. In these cases a small leather pad should be worn at the medial side of the sole.

During the night a simple apparatus, as in Fig. 3, is used. This consists of a steel belt, clasping the bony part of the pelvis at about the level of the spinæ anter. super., and the ends of which are

Fig. 3.



joined by a leather strap in front. Two steel rods are connected with this belt by simple joints and extend on the outside of the leg to 7 to 10 cm. below the flat of the foot. These rods are made longer than the limb, as the child is not to outgrow the apparatus during the long period in which it is to be worn. About a third of the distance between the ankle and knee, above the ankle, another steel band encloses the leg from the posterior side, and is

fastened on the anterior by a leather strap. The steel parts are all softly padded; the lower ends of the lateral rods are padded doubly, whence the thickness decreases as you approach the knee. At the knee, leather caps, secured by straps to the steel rods, press the knee outward. Before adjusting the apparatus the knees should be manipulated by hand for some minutes, and forced outward as far as possible without putting the patient in pain; then they are rubbed with some alcoholic fluid (brandy with salt), and finally put in the apparatus in a slightly flexed position, in which they can easily be drawn toward the rods. During sleep the knee sinks back, and the straighter the leg becomes, the more the knee will be drawn toward the steel rod, and the deformity corrected. The same result follows if the leg is extended voluntarily. Even restless children accustom themselves readily to the apparatus.

I have often asked myself whether this apparatus could, with such slight pressure, have any effect on the deformity. I think I can answer the question in the affirmative, as I have occasionally had opportunities of ascertaining such rapid improvement from the commencement of the night treatment, that I could not consider it due altogether to the *day* treatment. On the other hand, I have occasionally felt compelled to add to the day treatment that of the night.

The experience which I have had in the treatment of rhachitic deformities below the knee, by splints worn during the night only, goes to prove the same thing. Indeed, it suggested to me the idea of treating knock-knee in a similar manner.

BONE OPERATIONS FOR THE CORRECTION OF CLUB-FOOT, BASED UPON AN ANALYSIS OF 435 OPERATIONS BY 108 OPERATORS.

By H. AUGUSTUS WILSON, M.D.,
PHILADELPHIA.

While statistics are acknowledged to be of doubtful value at their best in establishing positive facts, still they often occupy important positions in the selection of the remedial measures that have the best chances of success at the least risk. The statistics that are here offered were gathered from a very large source, and while they may not embrace all the cases operated upon by the various operators whose names are given, nor all the cases thus operated upon by other surgeons, they include enough material from which to draw some inferences that will be of service.

The object sought was not to compare the results obtained by the various surgeons, but rather to ascertain: First, as to the statement often made that the mortality in bone operations in club-foot was a high one. Secondly, to ascertain the age of the patient when such operation was deemed advisable or expedient. Thirdly, the form of operation generally selected or the amount of bone tissue that was deemed necessary to remove in order to obtain correction. Fourthly, whether joint motion or ankylosis was sought. Fifthly, whether subsequent orthopedic apparatus or braces were required. Sixthly, whether the general usefulness of the foot was deemed better than could be obtained by other means. Seventhly, as to the selection of cases suitable for bone operation.

Under the head of mortality I have found but 3 cases out of 435 that died of septicæmia, while 3 deaths in addition are ascribed to

diarrhœa, and 1 other to carbolic-acid poisoning. One death from septicæmia followed three weeks after amputation, which was done for unavoidable hemorrhage after bone operation. Including all of these 7 cases only gives a mortality of 1.6 per cent. The wound was stated to be septic in 2 cases, and it is recorded that suppuration took place in 13 cases, making a total of 15 cases, or 3.45 per cent., in which this condition is stated as having occurred within two months after operation. Gangrene occurred in 1 case and required amputation, from which the patient recovered. In 2 cases, or 0.46 per cent., eczema was ascribed to the use of iodoform, and there were 2 cases, or 0.46 per cent., ascribed as a failure, but no explanatory statement was obtained. Erysipelatous inflammation occurred but once, or 0.23 per cent., so that it will be perceived that the statement with reference to the high mortality does not appear to be well established if these cases are taken as a basis. In the correspondence to be referred to subsequently it will be found that Dr. John Ashhurst, Jr., referred to a case of cuneiform osteotomy of the tarsus that he did in an adult, with subsequent amputation and death; and also that of Dr. Lewis A. Sayre, in which he refers to 2 cases, 1 of which had amputation done subsequently and the other died of septicæmia.

Secondly. The age of the patient when such operation was deemed advisable or expedient.

Excluding the 21 cases in which the age was not recorded (not stated, 15; as an infant, 2; as a child, 3; as an adult, 1), 414 cases are left ranging from three weeks of age to forty-seven years. Of this number, 234, or $53\frac{3}{4}$ per cent., were operated upon prior to the age of ten years; 126, or 29 per cent., prior to the age of six years; 29, or $6\frac{2}{3}$ per cent., prior to the age of two years; and 13 cases, or 2.9 per cent., prior to the age of one year. Between the ages of six and eighteen, inclusive, there were 240 cases operated upon, or $55\frac{1}{4}$ per cent. These, of course, clearly indicate that there is no age between the earliest months of infancy and the age of forty-seven years in which the operation has not been performed, and it is presumed that those who have operated at the early ages given were satisfied that it was justifiable to resort to such extreme measures at such an early period.

Age.	Cases.	Age.	Cases.
3 weeks	1	13 "	13
2 months	2	13½ years	1
2½ "	2	14 "	21
4 "	2	14½ "	1
5 "	1	15 "	16
6 "	2	16 "	6
7 "	2	17 "	5
10 "	1	18 "	9
12 "	1	19 "	3
15 "	5	20 "	4
16 "	1	21 "	8
17 "	1	22 "	6
18 "	6	23 "	1
20 "	2	24 "	1
2 years	7	25 "	5
2¼ "	1	27 "	2
2½ "	6	28 "	4
3 "	16	29 "	1
3½ "	7	30 "	1
4 "	33	31 "	1
4½ "	1	32 "	2
5 "	25	33 "	2
5½ "	1	35 "	1
6 "	30	36 "	1
6½ "	2	41 "	2
7 "	30	43 "	1
7½ "	1	44 "	1
8 "	17	47 "	1
9 "	25	Age not stated	15
9½ "	3	Infant	2
10 "	24	Child	3
11 "	15	Adult	1
12 "	21		
			435

I have been unable to ascertain the grounds for selecting bone operations in preference to other well-known and equally reliable procedures prior to the age of eight and twelve years, at which time it is presumed that the bones of the foot are firmly ossified and unyielding.

Thirdly. The form of operation generally selected:

	Cases.
Excision of astragalus	156
Excision of astragalus and cuboid	5
Excision of astragalus and cuboid and scaphoid	3
Excision of astragalus and cuboid and scaphoid and part of calcaneum	1
Carried forward	165

	Cases
Brought forward	165
Excision of astragalus and cuboid and scaphoid and part of calcaneum and three cuneiforms	1
Excision of astragalus and cuboid and part of calcaneum	3
Excision of astragalus and cuboid and part of cuneiform	1
Excision of astragalus and cuboid and part of calcaneum and scaphoid	2
Excision of astragalus and cuboid and part of calcaneum and scaphoid and external malleolus	2
Excision of astragalus and cuboid and part of scaphoid and external cuneiform	2
Excision of astragalus and cuboid, scaphoid, os calcis, and cuneiform	1
Excision of astragalus and scaphoid	7
Excision of astragalus and scaphoid and external malleolus	3
Excision of astragalus and part of scaphoid	1
Excision of astragalus and part of calcaneum	2
Excision of astragalus and part of calcaneum, cuboid, scaphoid, and wedge from tibia and fibula	2
Excision of astragalus and part of calcaneum and malleolus	1
Excision of astragalus and anterior end of calcaneum	7
Excision of astragalus, anterior end of calcaneum, and external malleolus	3
Excision of astragalus and resection of malleolus	8
Excision of astragalus and resection of cuboid and os calcis	1
Excision of astragalus and resection of tibia and fibula	1
Excision of astragalus and cuneiform osteotomy	6
Excision of head of astragalus	5
Excision of head of astragalus, neck and trochlea, and part of calcaneum	1
Excision of parts of astragalus, cuboid, cuneiforms (second and third)	2
Excision of parts of astragalus, cuboid, and scaphoid	1
Excision of anterior articular surface of astragalus	1
Wedge from head of astragalus and cuboid	2
Wedge through astragalus, cuboid, scaphoid, and os calcis	3
Wedge through astragalus, cuboid, scaphoid, os calcis, and one cuneiform	1
Wedge from neck of astragalus and calcaneum	1
Posterior section through neck of astragalus and part of calcaneum, anterior section through cuboid and cuneiform	1
Excision of tarsus from a line through neck of astragalus to metatarsus	2
Osteoplastic resection (Mikulicz-Vladmiroff)	1
Tarsectomy	12
Excision of whole of ankle-joint	1
Excision of wedge of tarsus	13
Excision of tarsus and external malleolus	2
Excision of cuboid	18
Excision of cuboid and cuneiform	1
Excision of cuboid, parts of external and middle cuneiform, scaphoid, and astragalus	4
Carried forward	291

	Cases.
Brought forward	291
Excision of scaphoid	4
Resection of cuboid	2
Resection of cuboid and half of first and second cuneiforms and all of third	1
Resection of cuboid and external cuneiform and os calcis	1
Excision of cuboid, external and middle cuneiforms, and part of scaphoid	1
Excision of cuboid, external and middle cuneiforms, and part of scaphoid and os calcis	1
Excision of wedge from cuboid	3
Excision of wedge from cuboid and scaphoid	1
Excision of wedge from cuboid, scaphoid, and cuneiforms (second and third)	1
Excision of wedge from cuboid and calcaneum	1
Excision of wedge at trans-tarsal joint	20
Linear osteotomy	8
Linear osteotomy of neck of calcaneum and astragalus	3
Linear osteotomy and cuneiform resection	8
Linear osteotomy and external malleolus	1
Linear osteotomy and excision of cuboid and scaphoid	2
Osteoclasis of tibia and fibula	9
Phelps'	14
Phelps', two wedges removed	2
Phelps', wedge from outer side of tarsus	3
Phelps', wedge from os calcis	1
Phelps', excision of cuboid	1
Phelps', excision of cuboid and parts of external and middle cuneiforms, scaphoid, and astragalus	1
Arthrodesis	6
Phelps', excision of cuboid, external and middle cuneiforms, and fifth, fourth, and third metatarsals	1
Phelps', excision of head of astragalus and part of calcaneum	2
Reeves' operation	6
	435

Note.—Five cases had double operations on same foot.

In 156 cases, or 36 per cent., the astragalus was the only bone removed. In 274 cases, or 63 per cent., not only was the astragalus removed but other surrounding bones were either removed entirely or in part, the greatest amount of removal being in a case where, together with Phelps' operation, the astragalus, cuboid, cuneiform, and scaphoid were removed. In 1 other case an osteoplastic resection was done. Tarsectomy, without describing the extent, was performed 12 times, or 2.7 per cent.; and in the same manner a wedge of tarsus was removed 78 times, or 18 per cent. In 25 cases, or 5.8 per cent., Phelps' operation was performed, and it is included

in this list of operations because, though not a bone operation, it was often done alone upon one foot of a patient and in connection with a bone operation upon the other foot, 14 times without bone operations, and 11 times accompanied with more or less extensive removal of bone from the same incision, or with an additional incision on the outer side of the foot.

The very extensive amount of bone removed in so many of the cases here recorded would seem to more clearly indicate the necessity for resorting to other measures to which Phelps has so ably drawn attention before attempting correction by removal of bone. The factors which are present in any given case of resistant club-foot involve resistance to correction as produced by one or other, or both, of the following conditions: First, there is an undoubted contraction or shortening on the inner aspect of the foot, while secondly, there is, as it were, a surplus on the outer side of the foot, together with elongation.

Many of the operations for the removal of bone seem to have been performed with the idea that it was necessary to remove enough tissue from the outer part to make the foot as short upon the outside as it was upon the inside, without any attempt, except in the 25 cases where Phelps' operation was performed, to elongate the inner aspect of the foot. This will undoubtedly explain the statement so frequently made in the statistics, that the foot after operation was preternaturally short and stumpy. Linear osteotomy of various parts, as devised and performed by E. H. Bradford, M.D., was done 22 times; osteoclasis of tibia and fibula, 9 times by Grattan; arthrodesis, 6 times; Reeves' operation, 6 times.

Fourthly. Whether joint motion or ankylosis was sought. It is a matter of very great regret that I was unable to obtain more definite information as to this question. Of course, it is only applicable to those cases where there was a removal of the astragalus only, or a linear osteotomy, for in nearly all other cases of bone excision, joint motion could not be expected, and, further, the subsequent usefulness of the foot naturally depended upon there being a firm bony union of the surfaces which were divided.

To my mind, the presence or absence of joint motion after excision of the astragalus is a most important element in deciding as to the expediency of resorting to the removal of this bone in certain resistant

cases. There is a certain class of cases occurring in adult life where all previous measures, whether operative or mechanical, have obtained a fairly good correction of the foot, but where there still remains slight inversion, the maintenance of the correct position of which depends upon the use of more or less heavy braces. In these cases it is usually found that when the foot is held in the everted right-angle position the whole form of the tarsal bones produces a jamming or crowding together at the ankle-joint which prevents full, free motion.

In many of these cases it would appear to me to be advisable to remove the astragalus, or so much thereof as might be necessary in order to free the joint from this condition of jam. The same condition would be favorable for a linear osteotomy, and equally good, if not better, functional results could be obtained. It has been my experience that in these cases the subsequent joint motion approaches very nearly to that of the natural foot, and renders it not only best but advisable to dispense with the use of the correcting apparatus.

Fifthly. Whether subsequent orthopedic apparatus or braces were required. With comparatively few exceptions, it is stated that braces or some form of apparatus or support were required in nearly all of the cases here recorded. The various reasons given for their use may be classified under the condition of muscular atrophy from disuse. In a great many of the cases it would appear to me that nothing had been gained except the appearance of correction, inasmuch as an apparatus, very nearly identical with that ordinarily employed, was required just as much after as before, and there was not a restoration of the mechanical functions.

Sixthly. Whether the general usefulness of the foot was better than could be obtained by other means.

Two others died of measles, and one other was supposed to have died of epilepsy, and two of consumption several years after operation.

It will be observed that the feet were not entirely corrected in 9 cases; unsatisfactory, 9; tendency to recur, 17; some subsequent operative procedure was required in 5, making 40 cases which the operator records as not being benefited. Amputation was done in 2 cases for pain.

Immediate Results within Two Months after Operation.

Foot in excellent condition	43
Foot satisfactory	75
Good	139
Wound healed	38
Perfect position; walks with ease	5
Foot normal shape	3
Bones firmly united	2
Wounds still open	5
Wound not aseptic	15
Tending to relapse	5
Amputation for uncontrollable hemorrhage; death in three weeks from septicæmia	1
Unsatisfactory	10
Erysipelatous inflammation	1
Gangrene—amputation	1
Failure	2
Eczema	2
Not stated	87
Extra sinus from drainage-tube	1
	435

Subsequent Results.

Walked with apparatus	16
Walks firmly	3
Walks without apparatus	13
Cured	26
Excellent	105
Good	100
Walks with ordinary shoe	7
Ankylosis	6
Recovery	26
Flat-foot	1
Not entirely corrected	9
Unsatisfactory	9
Tendency to recur	17
No voluntary motion	1
Subsequent operation	5
Painful—Symes' amputation	2
Slough	1
Death—carbolic acid poisoning	1
Death—diarrhœa	3
Death—septicæmia	3
Not stated	81
	435

It requires no statistics nor argument to emphasize the statement that were all cases of congenital club-foot treated from birth and maintained under careful observation for a safe time, no such

extensive operation as that of removing any portion of the tarsus would ever be required. In the class of cases in which may be classified relapsed cases, or those which have passed the period of infancy without attention, it is also a matter of experience that a very large majority, if not all, could be corrected by soft-structure section, either with manual or mechanical stretching and tearing, and the application of developmental methods; so that, to my mind the percentage of cases suitable for bone excision is extremely small. Under this heading, I believe, the statement that I have just made, based upon my own experience, could be emphasized by quoting from personal letters obtained in the course of my efforts to obtain these statistics.

LETTERS.

Newton M. Shaffer, M.D.: "I have no cases to report. As you know, my orthopedic work does not include any case that does not require special orthopedic care after operation, and these cases to which you refer I have sent to general hospitals. If your query was 'How many cases have you had which have been condemned to osteotomy and which you have cured without operation?' I could give you some statistics."

P. Lorenzen, M.D.: "Having five years ago collected the cases treated with bone operations before 1887, I have accepted the proposition made to me by Dr. Siegfried Levy, to answer your letter of the 4th of February, this year, and fill in your blank with these cases. There may be many more cases operated upon in the same manner afterward, but during the later years, most of the cases of severe club-foot have been corrected here in Copenhagen by division of the soft parts through open incision (after Phelps). I think it can only be a few, and my time not permitting me at this moment to look after them, I send you the before-mentioned cases in the hope that some of them may be of use to you."

Prof. A. Lorenz: "I consider every bone operation in club-foot as a mutilation of the foot and as a criminal act to the practice. Nine years ago I excised the talus in a double congenital club-foot, with moderately good results; since then I treat all cases with splints, and I am thereby enabled to change every club-foot, of

any degree and age, into a nearly normal foot. The paper concerning this treatment, which proves every operative procedure except section of the tendo Achillis as unnecessary, is in process of publication."

Ap Morgan Vance, M.D.: "I have done only one case of bone operation for the correction of club-foot, and that a few days before your letter came. This was the case of a girl baby two years of age whom I have treated continually since three months old. The bones were so much displaced that only an imperfect result was obtainable, hence the excision of the astragali, the cuboid on one foot being also removed. I think the result will be excellent, but it is too soon yet to report. This is the first case that I have met with where I considered the operation justifiable, except a few older cases who would not submit to any interference."

George Ryerson Fowler, M.D.: "At one time I was quite encouraged to think this operation one which would prove of great service. Later operations, however, have not confirmed this belief, and I have not resorted to it recently."

Flor. Bech, M.D.: "To my regret, I am unable to furnish a contribution to your work. With my patients who were afflicted with club-foot I have never felt the need of an operation (with the exception of subcutaneous separation of the tendons). I have always made out with powerful bending and pressing by means of the hands or with the assistance of apparatus. After every bending—which was undertaken, among other things, every week, or still oftener—the foot was fixed in the improved position by means of a plaster cast or an apparatus. I, of course, cannot wish to affirm that one will succeed by this method with all club-feet; by chance this method has sufficed with all patients whom I have had under treatment."

H. N. Burrell, M.D.: "Enclosed you will find what work I have done in the matter of osteotomy. I have found it rarely necessary, but both of these cases are satisfactory in their results."

Sir James Paget: "I am very sorry that I cannot supply you with any facts concerning bone operations for club-foot. They were, I think, very rarely performed during the time in which I was in the habit of operating."

E. Muirhead Little: "Your letter of the 4th inst. addressed to my father, Dr. W. J. Little, is before me, he having left it to me to reply to your question, as he has retired from practice and now lives in the country. Although it was at his suggestion that the first tarsectomy was performed by the late Mr. Solly; he himself never performed any operation on the bones for club-foot. His experience has been that tenotomy and well-directed instrumental and manual treatment sufficed to procure good results. If you care to have my own opinion, I would add that I have not, during the thirteen years that I have been connected with the Orthopedic Hospital here, done any bone operations for the cure of club-feet, but that I believe that in certain cases such an operation may be needed, but not in many. I have lately performed several open incision operations after the manner of Dr. Phelps. I am sorry that I cannot help your inquiry more."

Victor Horsley, M.D.: "I very rarely see a bad talipes requiring operation on the tarsus. All the cases of club-foot that come to me either at Queen's Square or University Hospitals are early cases for which tenotomy invariably suffices."

John E. Owens, M.D.: "I regret to say that I have no cases of bone operations for the correction of this deformity, nor do I think that the records of St. Luke's Hospital, of which I am one of the attending surgeons, possess any."

Sir W. MacCormac: "In regard to the table, I cannot, I regret, contribute to it."

Samuel Ketch, M.D.; "I am sorry to say that I have no personal cases to add to your report."

Basil Norris, M.D.: "I have no personal experience in such operations, and regret that I cannot assist you by contributing information or suggestions."

Royal Whitman, M.D.: "I have never performed the operation of excision of the astragalus, and am therefore unable to answer your questions. I have seen the operation several times, but only in cases of very marked deformity, when as a final result of any method of treatment, free motion could not have been expected. I think it an operation of last resort in neglected cases."

J. E. Moore, M.D.: "As you see, I have found it necessary to do bone operations very rarely. It seems rather strange that I have not operated more frequently, since I am a general surgeon; and, frankly, I am sure I would have done better in some of my cases if I had operated."

John Ashhurst, Jr., M.D.: "I have twice employed cuneiform osteotomy of the tarsus for varus, once in a child, a patient of Dr. Sydney Roberts, on both feet, successfully, and once in an adult with subsequent amputation and death. I have also twice removed the astragalus for varus and once for valgus, with good results. I regret that I have not recorded sufficient particulars of these cases to enable me to fill your blank."

W. R. Townsend, M.D.: "I think the operation is very seldom required except in cases seen late in life, where the increase in bone on one side is a mechanical impediment to reduction."

Dillon Brown, M.D.: "I am sorry to be unable to add to your list of cases as I have never performed any bone operations in a case of club-foot."

Robert W. Lovett, M.D: "I am sorry that I cannot give you any information about the question of bone operations for club-foot. It so happens that nearly all, if not all, of the bone operations that I have had have been simple cutting operations, and I do not think, as far as I can remember, that I have done any bone operations. If I have, it was so long ago that I have forgotten the details, and I cannot lay my hands on the case."

James K. Young, M.D.: "I regret that I have none to report at present. I have assisted Dr. Willard in a great many, but have avoided such operations in my own cases."

R. F. Weir, M.D.: "I have had no experience with the operation referred to in yours of the 4th inst. Regretting that I cannot aid you."

A. J. Steele, M.D.: "I have done no bone operations for club-foot. What I first knew of it, positively, was under Mr. Davy, over nine years ago. Osteotomy has its place in aggravated cases, but hereafter will rarely be necessary and never popular, because the

correct treatment of recent club-foot is becoming and will become so personally known that cases will be taken early and corrected."

John Homans, M.D.: "I have never done any bone operations for correction of club-foot—*i. e.*, any osteotomies."

N. Senn, M.D.: "I have usually succeeded in correcting club-foot by *brisement forcé* with or without tenotomy. Recently a man, aged twenty-five years, came into my clinic with a bony aggravated congenital club-foot. The only way in which I could get the foot into proper position was a combination of Dr. Phelps' operation and a cuneiform tarsectomy, removing a wedge-shaped section from outer aspect of tarsus. The functional result is perfect—three months after operation."

B. E. McKenzie, M.D.: "I have never performed any bone operations for the correction of club-foot deformity but once. In a case which I have not published, a boy, aged twelve years, had osteomyelitis when an infant, causing destruction of the lower growing area of the tibia. In consequence the foot was thrown inward and the bones greatly curved in the last four inches, causing great prominence of the external malleolus and causing the foot to roll over on its outer edge. I removed (December, 1891) a section of one inch from fibula, subperiosteally cut the tibia and replaced the foot. Healing by first intention; walking in three months; entire correction of the deformity; shortening two and a half inches; about half natural motion at the astragalo-crural joint. I should have said that after osteotomy I chiselled out the epiphysial cartilage from the end of the fibula, so as to prevent a recurrence of the deformity. Apart from the above, I have not found any bone operations necessary. In all other cases I have employed torsion, tenotomy, fasciotomy, and open incision. (In the case related above the boy uses a shoe having a cork sole of two inches, and his walking is greatly improved.)"

A. Cabot, M.D.: "I am sorry to say that I have no record of my club-foot cases, and have had very little experience in the resection of bone for this disease."

C. H. Mastin, M.D.: "It just so happens that in a large general surgical practice, one in which, from time to time, I have had a

number of club-foot cases, I have never as yet met one which I have not been able to correct satisfactorily to the patient as well as myself, by the use of well-constructed apparatus and aided by tenotomy. I do not in the least doubt, in some cases, the advisability of removing a part or more of the tarsal bones in order to correct a deformity which will not yield to less radical measures. The operations of my friend Morton, and his paper read before the American Surgical Association in one of the recent meetings, have convinced me of this fact. As I have said before, no case has as yet fallen under my observation which demanded such procedure, and hence I have not resorted to it."

Ansel G. Cook, M.D.: "I have done no bone operations for the relief of talipes, and am sorry there is nothing I can put on the enclosed blank."

William G. Porter, M.D.: "I have had no personal experience in bone operations for the correction of club-foot. I have twice excised the astragalus and performed numerous other operations on the bones of the foot, but not for the relief of club-foot."

Benjamin Lee, M.D.: "I have had no experience whatever in this class of operations."

John C. Schapps, M.D.: "I have never done any bone operations for these cases."

W. H. Carmalt, M.D.: "I have never done a bone operation for talipes."

Lewis A. Sayre, M.D.: "I have no personal experience in osteotomy for club-foot, having seen only two cases which I could not correct without this procedure. I gave one of these cases to Dr. Stephen Smith and the other to Dr. E. Mason. One had amputation done subsequently, and the other died of septicæmia."

A. Sydney Roberts, M.D.: "I never did an osteotomy for talipes."

T. Halsted Myers, M.D.: "It has been my custom to refer to the general surgeons, both in private and hospital patients, those cases of talipes which I thought needed operations on the bones, so I have no personal experience to give you."

J. Ewing Mears, M.D.: "I regret I have no cases of bone operations for the correction of club-foot to report."

Lewis A. Stimson, M D.: "I can only say that I have removed the astragalus for talipes only in the young; the immediate result has always been good, but the patients have always disappeared promptly from observation. Cuneiform osteotomy, or rather free removal of the tarsus through an outer incision, I have done only in adults or well-grown adolescents; the results, early and late, have been excellent. I make complete correction and use no brace afterward."

Reginald H. Sayre, M.D.: "I can only say that I have never as yet been obliged to perform any. In the cases I have seen which have been operated upon by other gentlemen, it seemed to me that the result was inferior to that which might have been secured by thorough division of such soft parts as prevented rectification of the deformity, supplemented by forcible rectification of deformity and careful after-treatment to prevent recurrence of distortion. In those cases where some of the bones of the leg and foot are wanting it may not be possible to secure a good foot except by bone operations, but in cases not complicated by such abnormalities it seems to me that bone operations must be *very* rarely necessary."

E. G. Brackett, M.D.: "I do not know that I shall be able to help you very much on the schedule, as most of my experience has been in operative club-foot upon very young children, where, of course, a bone operation is not called for."

A. B. Judson, M.D.: "I have no cases to report."

The Correction of Talipes-varus or Equino-varus by Excision of Astragalus, Cuneiform Osteotomy, or other Bone Operations.

1. Prof. Edmund Andrews. Not published. Patient 25 years of age. Extreme equino-varus. Opposite foot has talipes-valgus from former temporary infantile paralysis; corrected it by tenotomy and a brace which he still wears at last accounts. Excision of the whole ankle-joint Recovery. Permanent correction of deformity with ability to walk on the foot very well,

2. Drs. Augustoni and Panzeri. Archivio di Ortopedia, 1888, p. 172 et seq. Patient 4 years old. Equino-varus, right, congenital, grave. Tarsectomy Nov. 15, 1887. Everything proceeded regularly; discharged Jan. 22, 1888.

3. Same operators and reference. Patient 4 years of age. Equino-varus, right, congenital. Nov. 20, 1887, extirpation of the astragalus. Left the hospital perfectly cured after the regular course of treatment.

4. Same operators and reference. Patient 10 years of age. Equino-varus, right, congenital, grave. Atrophy of all the muscles of the leg. Nov. 11, 1887, extirpation of astragalus. Correction, with the very best result.

5. Same. Patient 10 years of age. Equino-varus, left, congenital, very grave. Atrophy of all the muscles of the leg. Extirpation of astragalus, Nov. 20, 1887 (with tenotomy of tendo Achillis). Correction, with very best result. (4 and 5 same sitting.)

6. Same. Patient 3 years of age. Equino-varus, right congenital, third degree. Dec. 9, 1887, extirpation of astragalus with resection of the plantar aponeurosis. Cure, and correction good. Braces.

7. Same. Patient 3 years of age. Equino-varus, right, congenital, very grave. Jan. 10, 1888, extirpation of astragalus. Issue very favorable.

8. Same. Patient 3 years of age. Equino-varus, left, congenital. Jan 10, 1888, tenotomy of tendo Achillis and resection of plantar aponeurosis. Issue very favorable. (7 and 8 same sitting.)

9. Same. Patient 7 years of age. Equino-varus, right, congenital, quite marked. Muscular atrophy. Sept. 9, 1886, extirpation of astragalus. Result quite satisfactory; cured in thirty days. Braces.

10. Same. Patient 5 years of age. Equino-varus, right, congenital; treated at home without results. April 2, 1887, extirpation of the astragalus. Correction good; discharged May 9, 1887. Braces.

11. Same. Same patient operated on for equino-varus, left, at same sitting; same result. Braces.

12. Same. Patient 6 years of age. Equino-varus, right, congenital. May 27, 1887, extirpation of astragalus. June 28, 1887, discharged with best results; permanently established a little later.

13. Same. Patient 5 years of age. Equino-varus, left; paralytic attack at two years of age; previous treatment without amelioration. July 5, 1887, extirpation of astragalus. Correction excellent; discharged Aug. 27, 1887.

14. Same. Patient 7 years of age. Equino-varus, left, congenital. Muscular atrophy. July 16, 1887, extirpation of astragalus. Issue again brilliant; cure effected within 26 days. (Same patient as Case 9.)

15. Same. Patient 4 years of age. Equino-varus, right, congenital; no previous treatment. Oct. 10, 1887, extirpation of astragalus. Issue favorable.

16. Same. Patient 11 years of age. Equino-varus, right, congenital, third degree. Nov. 4, 1887, tenotomy of tendo Achillis and resection of plantar aponeurosis, plaster bandages. April 24, 1888, "in view of the unsatisfactory results Dr. Panzeri resolved on subjecting the patient again to a cuneiform tarsotomy." Good correction of the equinism, but the varusism was not sufficiently corrected. Patient discharged cured, dated not stated. Braces.

17. Same. Same patient. Equino-varus, left. Operated on Nov. 9, 1887, Same result. Braces.

18. Same. Patient 11 years of age. Paresis and atrophy of the muscles of the left leg the result of infantile paralysis. March 11, 1888, extirpation of astragalus with section of aponeurosis. As soon as cure permitted she was provided with another brace and given massage, electricity, and passive gymnastics of the affected parts May 26, 1888, she was in the best condition, not only as to position, but also as to function of the limb. Braces.

19. Same. Patient 8 years of age. Equino-varus, left, paralytic, third degree. Date not given; extirpation of astragalus with section of plantar aponeurosis. July 10, 1888, walked. Good correction. Braces.

20. Same. Patient 13 years of age. Equino-varus, right, grave. June 27, 1888, extirpation of astragalus with section of plantar aponeurosis. Recovered so rapidly and so well that he was discharged on July 17, 1888, cured.

21. Same. Patient 15 years of age. Equino-varus, right, congenital, grave, Date not given, operation at house of Dr. Panzeri; extirpation of astragalus. Excellent correction of deformity and perfect use of limb. Apparently ankle-joint motion.

22. Drs. Augustoni and Panzeri. Lo Sperimentali, vol. lix., June, 1887, pp. 569–590. Patient 12 years of age. Equino-varus, left, accidental; considerable diminution of tactile sensibility in foot and leg; apparent dislocation of the fore-foot at every step causing a peculiar lameness. Marked atrophy of extensor and flexor muscles. Oct. 2, 1885, cuneiform tarsotomy with total removal of the astragalus and tenotomy of the tendo Achillis by method of Dr. Little, viz., from within outward. A month later found a perfect cure and an excellent position of foot, and the foot.

well united to the leg. Dec. 18, 1885, walked without any pain and without the aid of a stick. April 1, 1887, saw him again and observed perfect function and increase of nutrition of the limbs, and scarcely any perceptible limp. Ankle-joint movement almost normal.

23. Same authors and reference. Patient 9 years of age. Equino-varus, right, congenital. Sept. 15, 1886, cuneiform tarsotomy, removal of about 1 cm of the malleolus and the entire astragalus and section of aponeurosis. After 46 days cure complete; a well-marked rigidity existed opposite the new articulation of the foot and leg, almost to the degree of true ankylosis; foot had a good position, the sole squarely on the ground. Nov. 25 1886, walked without any aid; May 15, 1887, improvement maintained; slight limp, but good position of the foot maintained. Braces.

24. Dr. Beauregarde. Inaugural Diss. on the Treatment of Club-foot, 8 Bonn, 1884, p. 46. Patient 9 years of age. Equino-varus, right; unsuccessful tenotomy and orthopedics. April 25, 1882, excision of cuboid bone and section of tendo Achillis and plantar fascia. Entirely corrected; metal suture; Lister dressing; bulk festering. Patient walks with light apparatus which is more for a support to the weak, atrophied, small bones than to hold the foot corrected.

25. Same. Same patient. Equino-varus, left; unsuccessful tenotomy and orthopedics. Same results. Cites Bull. et Mém. de la Soc. de Chir., tome viii. p. 768; also refers to section of Davies-Colley, n. 53.

26. Same operator. Bull. et Mém. de Soc., Paris, 1880 (8), 775. Patient, male, 9 years of age. Equino-varus, left, congenital, severe. Excision of astragalus. Suppuration stopped after 15 days. Walks with a light apparatus. Several tenotomies had been done.

27. Same operator. Paris Thèsis, 1889–90, H. le Marc'hardam (cites Société de Chirurgie, 1882). Patient (age not given). Club-foot right, following infantile paralysis. Section of tendo Achillis, aponeurosis, plantaris, and long extensor of big toe.

28. Same operator and reference. Same patient. Club-foot, left, following infantile paralysis Excision of astragalus, cuboid, and part of the cuneiform. (One of four cases reported by Beauregarde, but no details for the others.)

29. Dr. W. H. Bennett. Trans. Clin. Soc. Lond., 1882, xv., pp. 81–84. Patient, male, 47 years of age. Talipes equino-varus, left, congenital, extreme. Foot so rigid and unyielding that no alteration obtained in shape without a great deal of force; toes could not be moved. June, 30, 1881, excision of wedge from cuboid and scaphoid, and tenotomy. Foot in excellent condition; wound healed July 28th, except a sinus from drainage-tube; Firm bony union. Oct. 6th, patient walked on crutches with foot in a splint; Nov. 21st, foot short, anterior part of sole fairly flat; heel slightly inverted; firm union, not bony; toes can be moved. Straight splint with the foot-piece; wore boots with iron supports. Nov. 3d. No ankle-joint motion as yet. Dressings not changed until July 8th. Carbolic acid caused great irritation, and on Aug 4th erysipelas set in, cicatrix was opened, all union between bones gave way. Aug 11th, still no union; healed Sept. 8th; plaster splint applied.

30. Dr. Berger. Bull. et Mém. de la Soc. de Chir. de Paris, 1890, xvi. pp. 55–57. Patient 9 years of age. Equino-varus, right, congenital; varus more marked than equinism; subluxation of forefoot on first range of tarsals. Calcaneum much elongated and frail, and external surface incurvate. Nov. 10, 1889, excision of astragalus through one dorsal incision, and resection of about 2½ cm. of anterior end of calcaneum. Jan. 3, 1890, walked well already. No trace of equinism. Varus has disappeared completely.

31. Same operator and reference. Same patient. Equino-varus, left. Dressings left in place for twenty-one days; wound completely healed.

32. Dr. Boeckel. Patient, male, 4 years of age. Equino-varus, congenital, left. 1882, removal of astragalus. Treated for three months. At seven months walked with apparatus. Plaster support. Tenotomy with apparatus; foot not greatly benefited.

33. Dr. Boeckel. Inaugural Diss. on Treatment of Club-foot, 8 Bonn, 1884. Ed. Springfield. Patient 6 years of age. Equino-varus right; right foot 12 cm. long, left 16 cm. long; previous treatment by tenotomy and orthopedics unsuccessful. June 13, 1878, resection of os cuboid, half of first and second cuneiforms and the third entirely. Coagulation, suppuration; July 17, wound closed. Steps well on foot, but yet shows strong disposition to deformity. May 21, 1883, right foot 13 cm. long, left foot 19 cm. long. Foot firmly fixed and immovable at an angle to leg; in-flexion yet present; calf muscles atrophied. Cites Bull. et Mém. de la Soc. de Chir., tome ix. 332.

34. Same operator and reference. Patient 4 years of age. High degree of congenital club-foot; astragalus is plainly visible before the tibia and forms a sharp protrusion on dorsum of foot. Already had nine months' treatment; section of tendo Achillis, twice done, right foot. May 7, 1879, excision of tarsus. Drainage, suture. Lister dressing; one day of fever. June 10th, good position, stands on entire foot sole, adduction of metatarsus on instep; foot has grown worse. Ankylosis. Apparatus. Ankle-joint motion slight. Cites Bull. et Mém. de la Soc. de Chir., tome ix. 333.

35. Same operator. Inaugural Diss. on Treatment of Club-foot, 8 Bonn, 1884, p. 46. Patient 3½ years of age. Pes varus, right, congenital. Three months of treatment. Better. Cites Bull. et Mém. de la Soc. de Chir., tome ix. p. 333.

36. Same operator and reference. Same patient. Pes varus, left, congenital; three months of treatment, no success; axis of foot makes an angle of 136° with leg. Nov. 28, 1882, excision of tarsus. Foot elevated, drainage, suture, iodoform bandage; severe hemorrhage after removal of Esmarch's bandage; slight suppuration and slight rise of temperature. Jan. 13, 1883, opening of abscess between tibia and tendo Achillis. Feb. 5, 1883, wound nearly closed. March 7 1883, entirely healed. Patient learned to raise foot in walking in month of March; no shortening in the leg.

37. Same operator and reference. Patient 6 years of age. High degree of club-foot, left; previous treatment by section of tendo Achillis and plaster bandage. Dec. 18, 1882, excison of tarsus, besides possibly a piece 1 cm long from the exterior malleolus. Jan. 15, 1883, wound healing; 27th, first tried to walk. March 1, 1883, sufficient movement in the tibio-tarsal joint; steps well on sole of foot, but somewhat more on outer edge.

38. Same operator and reference. Patient 6 years of age. High degree of club-foot, left; previous treatment by section of tendo Achillis and plaster bandages. Dec. 12, 1882, excision of tarsus. Foot in good position; plaster bandage.

39. Dr. Bollici. Archivio di Ortopedia, Milan, 1888, vol. v. pp. 428–433. Patient 27 years of age. Equino-varus, right, paralytic from five years of age; left also affected, but not operated upon at date of report. Greatly atrophied, especially the thigh. Nov. 29, 1888, subcutaneous tenotomy of tendo Achillis and plantar fascia; excision of astragalus (time of operation about one hour). Seventh day wound cicatrized, bones of leg were found to be "a little indirectly" over the foot; position corrected. 24th day returned to his house. Jan. 7, 1889, position of the foot perfect, "and when erect the sole rested flat," sustaining the weight of the body on the foot without much pain. Used a stick as a support; no braces. No ankle-joint motion.

40. Dr. Boursici, of Bordeaux. Bull. et Mém. de la Soc. de Chir. de Paris, 1891, pp. 510–511. Reported by E. Kirmisson. Patient 7 years of age. Talipes equino-varus, right, hereditary congenital; foot making a very open obtuse angle with axis of leg. Intercurrent scarlatina. July 23, 1890, excision of astragalus with subcutaneous section of tendo Achillis and plantar aponeurosis. July 30, 1890, great rise of temperature, scarlatina, abundant suppuration of wound, and persistent fissures In November healing complete. Braces. Mother and brother had club-feet.

41. Same operator and reference. Same patient. Talipes equino-varus, left, hereditary congenital; foot making a very open obtuse angle with axis of leg. Intercurrent scarlatina. Dec. 12, 1890, excision of astragalus with subcutaneous tenotomy of tendo Achillis and plantar aponeurosis. Cicatrization of tendonous sections by first intention, slight suppuration from astragalus wound. Equinus entirely corrected; slight tendency to varus remains; walks easily without appliances.

42. Dr. Boursier. Bull. et Mém. de la Soc. de Chir. de Paris, 1891, xvii. p. 509. Paper by E. Kirmisson. Patient age 25 years. Talipes equino-varus, left, acquired, atrophy from paralysis. April 1st, after electrical treatment for atrophy, subcutaneous tenotomy of tibialis anticus and plantar fascia, and tendo Achillis, and excision of astragalus. Septic conditions; rise of temperature, formation of pus, and purulent fissure. Beginning of June patient began to get up—could stand on ground without pain. Left on Sept. 1st completely cured.

43. Dr. E. H. Bradford. Boston Med. and Surg. Journ., 1888 (117), p. 285. Patient 7 years of age. Equino-varus, right, congenital. Excision of astragalus. Four months later slight valgus. Plaster-of-Paris support. Splint removed in a fortnight, and Taylor's appliance used to retain parts in position.

44. Same operator and reference. Patient, male, 12 years of age. Equino-varus. Excision of astragalus. Good result. Slight inward curvature.

45. Same operator and reference. Patient, male, 10 years of age. Equino-varus, double. Excision of astragalus. Good result. Slight inward curvature.

46. Same operator and reference, Patient, male, 6 years of age. Equino-varus. Excision of astragalus. Good result. Slight inward curvature.

47. Same operator and reference Patient, male, 10 years of age, Equino-varus. Excision of astragalus. Good result. Slight inward curvature.

48. Same operator and refereuce. Patient, female, 10 years of age. Equino varus. Excision of astragalus. Good result. Braces.

49. Same operator and reference. Patient (age not given). Equino-varus, double, congenital. Linear osteotomy of neck of calcaneum and astragalus. Very good results.

50. Same operator and reference. Patient (age not given). Equino-varus. Linear osteotomy of neck of calcaneum and astragalus. Good results.

51. Same operator and reference. Patient (age not given). Equino-varus. Linear osteotomy of neck of calcaneum and astragalus. Good results.

52. Dr. Brinkmann. Inaugural Diss. on "Resection in Pes Varus Congenitalis, 1885, pp. 14–15. Patient 4 years of age. Equino-varus, left, marked: foot shorter than the other; dislocated tarsus felt under the projecting malleolus; projection of internal malleolus and sole of foot bent in a crescent shape. May 17th, excision of astragalus and section of plantar fascia (strongly forced correction) with backward flexion and bandages. June 3d, wound healed by first intention. July 17th, foot perfectly normal.

53. Same operator and reference. Patient 18 years of age Equino-varus, right varus marked, equinus slight; tenotomy done several times in fourth and fifth year without success. Cuneiform tarsectomy of fore part of calcaneum and almost all of cuboid. Normal reduction still very difficult; eczema appeared and spread over foot and leg, but healed in five or six days; wound healed in three weeks. Imperfect use of foot. Plaster-of-Paris support.

54. Same operator and reference. Patient 1½ years of age. Equino varus, right, third stage; walking impossible; strong projection of ant. calcaneum process and of the astragalus, which was greatly deformed; plantar fascia and tendo Achillis very much strained. Excision of astragalus and cuboid bone, with teuotomy of tendo Achillis. Patient began to get up in three weeks.

55. Same operator. Same patient. Equino-varus, left, third stage. Operation and results the same.

56. Dr. Brinkmann. Aerzlicher Bericht k. k. Allg. Krankenhaus zu Wien, 1882, iv. p. 248. Patient 33 years of age. Talipes-equinus, right, accidental. Fracture of ankle-joint; constantly ulcerating scar. Cuneiform osteotomy in Chopart's articulation. Good results.

57. Same operator. Ibid., p. 250. Patient 28 years of age Talipes equino-varus, right from paralysis. Cuneiform tarsectomy in Chopart's articulation. Foot in excellent position. Deformity recurred through unequal muscular tension.

58. Same operator and patient. Talipes equino-varus, left, from paralysis. Forcible replacement and application of plaster bandage. Foot in excellent position. Deformity occurred through unequal muscular tension.

59. Wm. Bryant. Medical Times and Gaz., London, 1878, ii. 682. Patient, male, 10 years of age. Talipes equino-varus, right; extreme head of astragalus protruded on outside of foot, cuboid also prominent. Several swellings on outer side from pressure; tendo Achillis and anterior and posterior tibialis tense, and muscles of calf wasted. June 18, 1878, V-shaped piece removed from outer side scaphoid, greater part of cuboid, and articular surface of os calcis, astragalus and one cuneiform bone; two skin incisions were made, one on outer side for two inches, the other perpendicular to the first and extending from the dorsum to the side. July 11th, foot in good position; Aug. 20th, some tenderness in the sole. Nov. 25th, wounds quite healed, can put sole fairly and evenly on the ground; increased mobility in metatarso-phalangeal joints; foot now but little deformed. Ordinary side splint; July 4th, a back splint with foot-piece put on; July 11th, talipes splint; Aug. 20th, splint taken off; Sept. 14th, foot put in plaster-of-Paris. Ankle-joint somewhat mobile. Previous operations of tenotomy. In Oct., 1878, patient returned and had tendo Achillis divided; wound had not then healed and there were some prominent granulations on outer side.

60. Dr. Burrell. Not published. Patient 3½ years of age. Talipes equino-varus, right, grave. March 9, 1891, excision of astragalus, open tenotomy of tendo Achillis, and forcible correction with Bradford's twister. Good position, normal motion at ankle joint. Seen two years afterward: foot in perfect position. Plaster bandages. Ankle-joint motion. Patient has not consulted physician regularly.

61. Same operator. Same patient. Talipes equino-varus, left, congenital, grave. March 9, 1891, excision of astragalus, open section of tendo Achillis and plantar fascia. Slight tendency to varus, equinus corrected. Two years afterward slight tendency to varus, equinus corrected. Taylor's club-foot shoe with uprights extending to the pelvis. Ankle-joint motion.

62. Same operator. Patient 9½ years of age. Talipes equino-varus, right, congenital, very severe. Oct. 5, 1892, excision of head of astragalus, open section of tendo Achillis and plantar fascia, and position corrected by means of Thomas's wrench. Slight tendency to varus, but equinus corrected. Five months afterward some tendency to varus. Taylor's shoe with upright reaching to pelvis. Normal motion at ankle-joint.

63. Same operator. Same patient. Talipes equino-varus, left, congenital, very severe. Oct. 5, 1892, section of tendo Achillis one inch above insertion and division of plantar fascia after superficial dissection of the skin, and corrected position by Thomas's wrench. Slight equinism, varus corrected. Five months afterward, normal position; slight varus easily corrected by manipulations. Plaster bandages. Normal motion of ankle-joint.

64. Dr. P. V. Butz. Chir. Vestnik, Surg. Messenger, St. Petersburg, vol. v. pp. 550–551. Patient 28 years of age. Equino-varus, slight swelling in ankle first noticed at sixteen years of age. Poorly nourished. Oct. 15, 1887 (o.s.), osteoplastic resection of tarsus by method of Vladmiroff and Mickulicz. The disease being over twelve years' standing, the wound was over sixty days in casting off the diseased material and in cicatrizing. In 2½ months patient walked with crutches, stepped without pain; in 3½ months walked with a stick alone; in 4½ months walked easily and rapidly without stick, wearing a boot with steel side strips; cicatrix not sensitive, can walk barefooted without supports; discharged March 26, 1888. Light ankle-joint motion. Vladmiroff's operation, reported in his dissertation, Kazan, "Several Osteoplastic Operations on the Foot." Resection of articular portions of tibia and fibula and posterior surfaces of the scaphoid and cuboid. For Micuicz's system see Archives f. Chir., xxvi. p. 497.

65. Dr. L. Championnière. Thesis for the Doctorate of Medicine (Faculté de Méd. de Paris), 1889, by J. Martin. Patient 18 years of age. Equino-varus, left, very marked, paralytic. Marked muscular atrophy; leg not atrophied. June 2, 1883, excision of astragalus and section of tendo Achillis. Equinus corrected, but the varus redressed with difficulty. Oct. 20th, left the hospital, walked with a brace. Braces. Patient abandoned the brace in following May, but in 1888 broke the leg by a fall from a carriage, and had to resume it.

66. Same operator and reference. Patient 18 years of age. Equino-varus, paralytic; deformity considerable and almost entirely equinus; foot only reaches ground at extremity of first metatarsal and little toe; can only progress by leaping. Convulsions at three years, andparalysis of muscles of leg. April 26, 1888, external incision before the malleolus and then internal incision outside of anterior tibial tendon; operation laborious, especially in the disengagement of the astragalus post.; Esmarch's bandage used, open section of tendo Achillis. March 3, 1889, walked easily; carries the foot quite flatly. Braces.

67. Same operator. Bull. et Mém. de la Soc. de Chir. de Paris, 1890, xvi. p. 96. Patient 15 years of age. Double club-foot. May 12, 1887, excision of right astragalus. A chloroform accident, artificial respiration; reunion without suppuration; fair result. Discharged March 4, 1888.

68. Same operator and reference. Patient 15 years of age. Equino-varus, left, paralytic (very painful in walking) Sept. 6, 1888, excision of astragalus with section of tendo Achillis (Esmarch's bandage used. Left hospital Oct. 29th; results immediately good.

69. Same operator and reference. Patient 9 years of age. Paralytic equino-varus, left. May 9, 1888, excision of astragalus and section of tendo Achillis. Drainage; union by first intention. Sept. 1, 1889, result excellent, walks and runs with ease. Light lateral braces.

70. Same operator and reference. Patient 15 years of age. Equino-varus of right foot. Sept. 12, 1889, excision of astragalus and section of tendo Achillis. Discharged Nov. 12th, in very good condition; walks straight and almost without limping. Shoe and braces.

71. Same operator. Ibid. 1891, xvii. p. 512. Patient 15 years of age. Talipes valgus. Rheumatic and cardiac complications. Excision of astragalus, April 11, 1890. Form of foot restored; painfulness relieved, but functional results not good because of the obstinacy of the patient, he refusing exercises, etc. Braces.

72. Same operator and reference. Patient 18 years of age. Talipes valgus. Excision of astragalus, July 31, 1890.

73. Same operator. Paris Thesis (cites Bull. et Mém. de Soc. de Chir.). Patient 20 years of age. Equino-varus, right foot smaller than left; equinus marked. Began at 13 months, after an attack of convulsions; muscles of leg atrophied, especially the gmelli and soleus. July 26, 1888, excision of astragalus, section of ligamentum talo-naviculare and lig. cruciatum cruris (sig. en X), open tenotomy of tendo Achillis and excision ot cuboid. Marked varus remains, but results were quite good and no pain or febrile reaction. Left in good condition; sole of foot placed well on the ground; no more equinus or varus; walking is easy and not painful. Ankle-joint motion.

74. Same operator. Paris Thesis, 1889-90, H. le Marc'hardam. Patient 10 years of age. Equino-varus paralytic; varus slight but equinus marked. Very marked atrophy of muscles of the calf. May 9, 1888, excision of astragalus and cuboid. No suffering after operation; first attempt at walking not painful. A year and a half later: walking easy and absolutely correct; can run and jump the rope, and all without apparatus; muscles recuperating.

75. Same operator. Bull. et Mém. de la Soc. de Chir. de Paris, 1890, xvi. p. 89. Patient 19 years of age. Equino-varus, right, following infantile paralysis; very marked. Atrophy of muscles of leg. June 21, 1889, excision of astragalus, cuboid, scaphoid, and anterior half of calcaneum; open tenotomy of tendo Achillis. Suffering for four or five days, but no rise of temperature; six weeks later foot solid enough to sustain weight of body, in perfect shape, and a shoe with lateral supports was put on for prudence. Two months after operation walks perfectly without the shoe, sole well placed on the ground; muscles slowly regaining strength.

76. Dr. E. Charon. Journ. de Méd. de Chir. et de Pharm.,. Brussels, 1888, vol. lxxxvi. p. 267. Patient 6 years of age. Equino-varus. Atrophy from disuse. 1885, Dr. Gross's (of Nancy) operation was done: excision of astragalus from right side, resection of external malleolus and a portion of the os calcis Foot was not even helped.

77. Same operator. "Chirurgie Infantile," Brussels, Lamartin, ed. 1891, p. 36. Patient 6 years of age. Equino-varus. Extirpation of astragalus, resection of external malleolus. Excellent result. Braces. Ankle-joint motion.

78. Same operator. Ibid. p. 299. Patient 4 years of age. Equino-varus. Extirpation of astragalus. Perfect correction. Five months after result satisfactory. Braces.

79. Same operator. Du Traitement Chirurgicale des Pieds Bots Congenit., Brussels, 1891, p. 7. Patient 10 years of age. Equino-varus. Extirpation of astragalus. Perfect correction. Walks easily on the entire plantar surface of foot. Braces.

80. Same operator. Journ. de Med., de Chir., de Pharm , Brussels, 1888, vol. lxxxvi. p. 257. Patient 9 years of age. Equino-varus, right. March 20, 1888, excision of astragalus. April 9th, foot at a right angle in plaster bandage; May 8th, walks with ease upon the sole of the foot, no lameness, serous bursa disappears. Braces.

81. Dr. J. M. Cotterill. Trans. Clin. Soc. Lond., and Edinb. Med. Journ., 1884–5. Woman. Talipes equino-varus. Excision of cuboid and external cuneiform. Weight and pulley. Cured.

82. Mr Croft. Med. Times and Gaz., Lond., 1883. Patient, female, 8 years of age. Equino-varus, right, congenital, rigid, inversion of foot, fibula back of tibia, 2½ inches shortening in the leg. Muscular atrophy. July 1, 1882, removal of parts of scaphoid, internal and middle cuneiform bones and cuboid. Healed in three weeks; placed sole of foot on floor in four weeks. Discharged August 1, 1883.

83. Same operator and reference. Patient, male, 12 years of age. Equino-varus, congenital, foot rigid. Date not stated; excised a wedge of bone from tarsus. Healed in three weeks. Wore boot with iron supports for six months. Child sat up July 4th; wound healed and child discharged on July 22d.

84. Dr B. F. Curtis. Unpublished. Patient about 3 years of age. Equino-varus. Excision of astragalus. Practical correction. One year after front of foot tended to adduct, but sole was flat. Judson's brace. Ankle-joint motion. Case had previously been treated by hand-stretching, brace-stretching, tenotomy, and Phelps's operation.

85. Dr G. G. Davis. N. Y. Med. Journ., Oct. 1, 1892. Patient 12 years of age. Equino-varus, right, congenital, sole vertical and turned inward at 90° to ant. post. axis. About Dec. 1891, anterior section through cuboid and cuneiform. Posterior section through neck ef astragalus, and anterior part of os calcis. Absolute correction; sole flat on ground in its whole extent. Eight months later foot in excellent position, no pain or trouble in any way. Braces used. Ankle-joint motion about 10° or 15°.

86. Same operator and reference. Patient 21 years of age. Equino-varus, right, sole vertical, and rotated in 90°. Excision of three cuneiforms, cuboid, scaphoid, astragalus, and anterior part of os calcis. Foot short but in excellent position; sole flat on ground. Thirteen months later most excellent; walks without brace, and foot in excellent position. Braces used. Ankle-joint motion about 10°. A very marked case, and very gratifying result. Shortening of foot was considerable, but straightening could not be done without it.

87. Same operator. N. Y. Med. Journ., October 1, 1892. Patient 21 years of age. Equino-varus, right, congenital, sole vertical and foot turned inward at 90° to anterior-posterior axis. No complications. Excision of tarsus from metatarsals in front to line drawn through neck of astragalus and anterior part of os calcis in front of ankle-joint and section of tendo Achillis and plantar fascia. Excellent results; perfect reposition. Six months later walking much improved; no pain. Braces required. About 15° of motion.

88. Same operator and reference. Same patient. Equino-varus, left, congenital, sole vertical and foot turned inward at 90° to anterior-posterior axis. No complications. Excision of tarsus from metatarsals in front to a line drawn through neck of astragalus and anterior part of os calcis in front of ankle-joint, with section of tendo Achillis and plantar fascia. Excellent results; perfect reposition. Six months later walking much improved; no pain. Small sinus existed from which a small spicule of bone was discharged. Braces required. About 15° of motion.

89. Dr. Davies-Colley. Bryant's Surgery. Patient, male, 12 years of age. Equino-varus, right. June 18, 1878, excision of astragalus, scaphoid, calcaneus cuneiform and cuboid. July 11th, bones fairly united, wound nearly closed. September 10th, sole of foot flat. November 10th, can walk fairly well. Distal splint and limb swinging. Temperature went up to 102.4° next day, fell day after. Immovable splint applied September 10th. Boy returned October 20th to have tendo Achillis cut and more motion at ankle-joint obtained.

90. Dr. R. Davy. British Med. Journ., London, 1883, p. 899. Patient, male, 15 years of age. Talipes varus, left, congenital. January 27, 1874, excision of cuboid. Discharged May 27, 1874. Plaster-of-Paris with flat steel sole under plaster. Recovery.

91. Same operator and reference. Same patient. Talipes varus, right, congenital. March 17, 1874, excision of cuboid. Discharged May 27, 1874. Plaster-of-Paris with flat steel sole under plaster. Recovery.

92. Same operator and reference. Patient, male, 14 years of age. Equino-varus, right. January 18, 1875, excision of cuboid. Discharged April 11, 1875. Plaster-of-Paris with flat steel sole under plaster. Recovery.

93. Same operator and reference. Patient 10 years of age. Equino-varus, right. January 26, 1875, excision of cuboid. Discharged May 26, 1875. Plaster-of-Paris with flat steel sole under plaster. Recovery.

94. Same operator and reference. Same patient. Equino-varus, left. January 26, 1875, excision of cuboid. Discharged May 26, 1875. Plaster-of-Paris with flat steel sole under plaster. Recovery.

95. Same operator and reference. Patient, male, 6 years of age. Equino-varus, left. March 28, 1876, excision of osseous wedge at transtarsal joint. Discharged May 22, 1876. Plaster-of-Paris with flat steel sole under plaster. Recovery.

96. Same operator and reference Patient, male, 12 years of age. Equino-varus, right. November 4, 1876, excision of osseous wedge at transtarsal joint. Discharged May 21, 1877. Plaster-of-Paris with flat steel sole under plaster. Recovery.

97. Same operator and reference. Same patient. Equino-varus, left. January 16, 1877, excision of osseous wedge at transtarsal joint. Discharged May 21, 1877. Plaster-of-Paris with flat steel sole under plaster. Recovery.

98. Same operator and reference. Patient, female, 1½ years of age. Equino-varus, right. March 5, 1878, excision of osseous wedge at transtarsal joint. Discharged April 12, 1878. Plaster-of-Paris with flat steel sole under plaster. Recovery—38 days in hospital.

99 Same operator and reference. Patient, male, 20 years of age. Talipes equinus, left. November 20, 1877, excision of dorsal wedge. Discharged December 5, 1877. Plaster-of-Paris with flat steel sole under plaster. Death in 14 days from septicæmia.

100. Same operator and reference. Patient, male, 16 years of age. Congenital; equino-varus, right. May 31, 1878, excision of wedge at transtarsal joint. Discharged August 29, 1878. Plaster-of-Paris with flat steel sole under plaster. Recovery.

101. Same operator and reference. Patient, male, 14 years of age. Equino-varus, left. May 25, 1878, excision of wedge at transtarsal joint. Discharged July 31, 1878. Plaster-of-Paris with flat steel sole under plaster. Recovery.

102. Same operator and reference. Patient, male, 10 years of age. Varus, right. July 8, 1879, excision of wedge at transtarsal joint. Discharged September 9, 1879. Plaster-of-Paris with flat steel sole under plaster. Recovery.

103 Same operator and reference. Patient, male, 4 years of age. Varus, left. June 7, 1881, excision of wedge at transtarsal joint. Discharged July 22, 1881. Plaster-of-Paris with flat steel sole under plaster. Recovery.

104 Same operator and reference. Patient, male, 10 years of age. Paralytic equino-varus, right. June 14 1881, excision of wedge at transtarsal joint. Discharged July 9, 1881. Plaster-of-Paris with flat steel sole under plaster. Recovery.

105. Same operator and reference. Patient, male, 11 years of age Equino-varus, right. August 4, 1881, excision of wedge at transtarsal joint. Discharged October 21, 1881. Plaster bandage with steel sole under the plaster. Recovery.

106. Same operator and reference. Patient, male, 5 years of age. Talipes varus, right. November 29, 1881, excision of wedge at transtarsal joint. Discharged February 13, 1882. Plaster bandage with steel sole under the plaster. Recovery.

107. Same operator and reference. Patient, female, 4 years of age. Congenital varus, right. March 31, 1882, transtarsal joint excised. Discharged June 1, 1882. Plaster bandage with steel sole under the plaster. Recovery.

108. Same operator and reference. Same patient. Mal-development, left. March 31, 1882, transtarsal joint excised. Discharged June 1, 1882. Plaster bandage with steel sole under the plaster. Recovery.

109. Same operator and reference. Patient, female, 13 years of age. Equino-varus, left. June 6, 1882, excision of wedge at transtarsal joint. Discharged September 9, 1882. Plaster bandage with steel sole under the plaster. Recovery.

110. Same operator and reference. Patient, male, 13½ years of age. Congenital varus, double. June 20, 1882, excision of wedge at transtarsal joint. Discharged August 21, 1882. Plaster bandage with steel sole under the plaster. Recovery.

111. Same operator and reference. Patient, male, 10 years of age. Congenital equino-varus, left. June 26, 1883, transtarsal joint excised. Discharged December 19, 1883. Plaster bandage with steel sole under the plaster. Recovery; 175 days in hospital.

112. Same operator and reference. Patient, male, 7 years of age. Congenital equino-varus, right July 10, 1883, excision of transtarsal joint. Discharged October 19, 1883. Plaster bandage with steel sole under the bandage. Recovery.

113. Same operator and refereuce. Patient, female, 4 years of age. Congenital equino-varus, right. November 20, 1883, excision of transtarsal joint. Discharged March 21, 1884. Plaster bandage with steel sole under the plaster. Recovery.

114. Same operator and reference. Patient, male, 18 years of age. Congenital equino-varus, left. Toes upside down. January 11, 1884, excision of rectangular wedge at transtarsal joint. Discharged March 21, 1884. Plaster bandage with steel sole under the plaster. Recovery.

115. Dr. Deschamps. Unpublished. Patient 4½ years of age. Equino-varus. No complications. 1885, excision of astragalus. Good results five months later. Barwell's apparatus. Slight ankle-joint motion.

116. Same operator. Patient 4 years of age. Equino-varus. No complications. 1886, excision of astragalus Good results five months later. Slight ankle-joint motion.

117. Same operator. In Dunulleno, Traitement des Deformities Congenitales. Patient 14 years of age. Equino-varus. No complications. 1886, excision of astragalus. Good results. Slight ankle-joint motion. Died 3 years later of consumption.

118. Same operator. Patient 4 years of age. Equino-varus. 1887, excision of astragalus. Bad results. Sayre's apparatus. Ankylosis.

119. Same operator. Patient 5 years of age. Equino-varus. 1887, excision of astragalus. Good results. Slight ankle-joint motion.

120. Same operator. Patient 7 years of age. Equino-varus. 1887, excision of astragalus. Good results 4 years later. Slight ankle-joint motion.

121. Same operator. Patient 5½ years of age. Equino-varus. 1887, excision of astragalus. Good results. Slight ankle-joint motion.

122. Same operator. Patient 6 years of age. Equino-varus. 1887, excision of astragalus. Good results Slight ankle-joint motion.

123. Same operator. Patient 7½ years of age. Equino-varus. 1887, excision of astragalus. Good results. Slight ankle-joint motion.

124. Same operator. Patient 10 years of age. Equino-varus. 1888, excision of astragalus. Satisfactory results. Nélaton's apparatus. Ankylosis.

125. Same operator. Patient 14 years of age. Equino-varus. 1888, excision of astragalus. Good results. Barwell's apparatus. Slight ankle-joint motion.

126. Same operator. Patient 12 years of age. Equino-varus. 1888, excision of astragalus. Good results 2 years after. Slight ankle-joint motion.

127. Same operator. Patient 13½ years of age. Equino-varus. 1889, excision of astragalus. Bad results. Sayre's apparatus. Ankylosis.

128. Same operator. Patient 9 years of age. Equino-varus. 1890, excision of astragalus. Good results. Barwell's apparatus. Aukle-joint motiou.

129. Same operator. Patient 6 years of age. Equino-varus. 1890, excision of astragalus. Slight ankle-joint motion.

130. Same operator. Patient 6½ years of age. Varus. 1891, excision of astragalus. Slight ankle-joint motion.

131. Same operator. In Dunulleno, Traitement des Deformities Congeuitales du Pied. Patient 21 years of age. Valgus acquired. 1887, osteotomy of fibula and cuneiform osteotomy of the ant. ankle cone. Good results 2 years after. Ankle-joint motion. Died 2½ years later of consumption.

132. Same operator. Patient 7 years of age. Equino-varus. 1887, cuneiform osteotomy. Good results 3 years later. Ankle-joint motion.

133. Same operator. Patient 6 years of age. Equino-varus. 1888, cuneiform osteotomy. Good results. Ankle-joint motion.

134. Same operator. Patient 6½ years of age. Equino-varus. 1889, cuneiform osteotomy. Good results. Ankle-joint motion.

135. Same operator. Patient 6 years of age. Equino-varus. 1890, cuneiform osteotomy. Satisfactory results. Sayre's apparatus. Slight ankle-joint motion.

136. Same operator. Patient 5 years of age. Equino-varus. 1893, cuneiform osteotomy. Good results. Ankylosis.

137. Same operator. Gazette Medicale de Liége. Patient 7 years of age. Equino-varus, paralytic. 1889, arthrodesis. Good results. Ankylosis.

138. Same operator and reference. Patient 9½ years of age. Equino-varus. 1888, arthrodesis. Good results. Aukylosis.

139. Same operator. Patient 6 years of age. Equino-varus, paralytic. 1888, arthrodesis. Good results. Ankylosis.

140. Same operator. Patient 5 years of age. Equino-varus. 1889, arthrodesis. Good results 2 years after. Ankylosis.

141. Same operator. Patient 5 years of age. Equino-varus. 1890, arthrodesis. Good results 1 year after. Ankylosis.

142. Same operator. Patient 7 years of age. Equino-varus. 1891, arthrodesis. Good results. Ankylosis.

143. Same operator. Patient 18 years of age. Valgus; pain. 1885, excision of scaphoid. Good results. Ankle-joint motion.

144. Same operator. Patient 8 years of age. Valgus; pain. 1886, excision of scaphoid. Good results. Ankle-joint motion.

145. Same operator. Patient 9 years of age. Valgus; pain. 1889, excision of scaphoid. Good results. Ankle-joint motion.

146. Same operator. Bulletins de l'Academie. Patient 2 years of age. Equino-varus. 1888, Phelps' operation. Good results. Sayre's apparatus. Ankle-joint motion.

147. Same operator and reference. Patient 10 years of age. Equino-varus. 1888, Phelps' operation. Good results 3 years after. Ankle-joint motion.

148. Same operator and reference Patient 7 years of age. Equino-varus. 1889, Phelps' operation. Good results. Ankle-joint motion.

149. Same operator and reference. Patient 2½ years of age. Equino-varus. 1889, Phelps' operation. Good results. Ankle-joint motion.

150. Same operator. Patient 2 years of age. Equino-varus. 1890, Phelps' operation. Good results 2 years after. Ankle-joint motion.

151. Same operator. Patient 4 years of age. Equino-varus. 1890, Phelps' operation. Satisfactory results. Plaster-of-Paris. Ankle-joint motion.

152. Same operator. Patient 7 years of age. Equino-varus. 1890, Phelps' operation. Good results. Ankle-joint motion.

153. Same operator. Patient 9 years of age. Equino-varus. 1891, Phelps' operation. Good results. Ankle-joint motion.

154. Same operator. Patient 8 years of age. Equino-varus. 1892, Phelps' operation. Good results. Ankle-joint motion.

155. Same operator. Patient 1 year of age. Equino-varus. 1893, Phelps' operation. Good results. Ankle-joint motion.

156 Same operator. Bulletins de l'Academie. Patient 10 years of age. Equino-varus. 1888, Reeves's operation. Good results. Ankle-joint motion.

157. Same operator and reference. Patient 5 years of age. Equino-varus. 1889, Reeves's operation. Good results. Ankle-joint motion.

158. Same operator and reference. Patient 3½ years of age. Equino-varus. 1889, Reeves's operation. Good results 2 years later. Ankle-joint motion.

159. Same operator. Patient 6 years of age. Equino-varus. 1890, Reeves's operation. Good results 2 years later. Ankle-joint motion.

160. Same operator. Patient 7 years of age. Equino-varus. 1890, Reeves's operation. Good results 2 years later. Plaster-of-Paris. Ankle-joint motion.

161. Same operator. Patient 3 years of age. Equino-varus. 1891, Reeves's operation. Good results 2 years later. Ankle-joint motion.

162. Same operator. Dr. Meillem Traitement des Deformities Cong. du Pied. Dr. J. Deschamps, Liége, 1889, No. 40. Patient 14 years of age. Equino-varus, right. Excision of astragalus and cuboid, and resection of anterior part of calcaneum. Straightening imperfect until after ablation of cuboid, then complete. Foot perfectly restored, but short; slight equinus remains. Braces.

163. Dr. Dumont (cited from Schwartz Thesis). Paris Thesis, 1889–90, H. le Marc'hardam. Patient 9 years of age. Equino-varus, marked. Ablation of astragalus. Results satisfactory.

164. Same operator and reference. Patient 33 years of age. Equino-varus. Ablation of astragalus. Results satisfactory; marked lameness remains.

165. Dr. Duret. Bull. et Mém. de la Soc. de Chir. de Paris, xiii.,1887, p. 694; reported by M. Polaillon. Patient 6 years of age. Equino-varus, right, congenital, and paralytic scaphoids greatly atrophied. Atrophy of muscles very marked. Tenotomy of tendo Achillis and retracted muscles; excision of anterior two-thirds of cuboid, part of head of astragalus, and parts of two cuneiforms (2d and 3d). Three months later foot rests on sole in walking, heel lowered, foot straight. Braces.

166. Same operator and reference. Same patient. Equino-varus, left, congenital and paralytic scaphoids greatly atrophied. Marked atrophy of muscles. Excision of anterior two-thirds of cuboid, part of head of astragalus, and parts of 2d and 3d cuneiforms; tenotomy of tendo Achillis and retracted tendons. Three months later not so good as the other one; uses appliances but can walk without them.

167. Dr. F. R. Fairbank. Brit. Med. Journ., Lond., 1887–78, ii., p. 933. Patient 41 years of age. Equino-varus, left, deformity extreme. April 15, 1887, excision of tarsal bones and section of tendo Achillis and plantar fascia; side incisions. Long and tedious recovery because of suppuration and bronchial trouble. Foot short but firm; good bony union. Plaster-of-Paris splint. Walks well and easily and works steadily.

168. Same operator and reference. Same patient. Equino-varus, right, deformity extreme. November, 1887, excision of tarsals and section of tendo Achillis and plantar fascia (modified Davies-Colley's operation); side incision for excision. Wound healed slowly. Foot short but firm and strong and quite straight; walks without support. Discharged February 6, 1888. January 4, 1888, plaster put on with a fenestrum over the wound. Can walk several miles without fatigue or pain.

169. Dr. Ferrier. Thesis for the Doctorate of Med., Faculty de Med., Paris, 1889, by J. Martin. Patient 6 years of age. Equino-varus. Excision of astragalus. Second operation required; result unsatisfactory.

170. Trois Fontaines. Annales de la Société Médico-Chirurgicale de Liége, 1884, p. 274. Patient 9 years of age. Equino-varus. Cuneiform osteotomy of tarsus. Satisfactory results within 2 months. Excellent result 9 years after. Braces for 2 months. Limited flexion but complete extension to normal degree.

171. Dr. G. R. Fowler. Patient 7 years of age. Equino-varus, right, extreme. March, 1886, excision of cuboid and parts of cuneiform, scaphoid and astragalus. Complete restoration. Four months later, very good position. Braces as a preventive. Ankle-joint motion.

172. Same operator. Same patient. Equino-varus, left, extreme. March, 1886, excision of cuboid and parts of cuneiform (ext and mid.), scaphoid and astragalus. Complete restoration. Four months later, very good position. Braces as a preventive. Ankle-joint motion.

173 Same operator. Patient 6 years of age. Equino-varus, right, extreme. November, 1887, excision of cuboid and portions of external and middle cuneiforms, scaphoid and astragalus. Complete restoration. Three months later an extensive bony deposit at site of operation caused inversion; removed, and three months later a similar deposit again occurred, but not so extensive. Braces to maintain position. Ankle-joint motion.

174. Same operator. Same patient. Equino-varus, left, extreme. November, 1887, excision of cuboid and portions of external and middle cuneiforms, scaphoid and astragalus, by Phelps's operation. Complete restoration. Braces to maintain position. Ankle-joint motion.

175. Same operator. Patient 5 years of age. Equino-varus, left. February, 1889, excision of cuboid and parts of external and middle cuneiforms and astragalus. Complete restoration. Four and a half months later, bony deposits very marked at site of operation. Plaster-of-Paris for two months, but no brace. Ankle-joint motion.

176. Same operator. Same patient. Equino-varus, right, varus more marked. February, 1889, excision of cuboid and Phelps's incision added. Complete restoration. Four and a half months later, marked bony deposits at site of operation. Plaster-of-Paris for two months, but no brace. Ankle-joint motion.

177. V. P. Gibney. Boston Med. and Surg. Journ., 1890, cxx., 278. N. Y. Acad. of Med. Patient, female, 25 years of age. Equino-varus, right; usual force unsuccessful. Dec. 26, 1887, cuneiform osteotomy. Septicæmia until Feb. 16th. Feb. 16th, wounds healing nicely, and foot in excellent position; walks quite well. Thomas's club-shoe over plaster of Paris. After section of bones and free division of deltoid lig. and plantar fascia, it was impossible to straighten foot, so free lateral incisions were made through muscles and tendons after Phelps.

178. Same operator and reference. Same patient. Equino-varus, left (same as above). Feb. 22, 1888, cuneiform osteotomy. Healing by first intention. Good result. Plaster-of-Paris support.

179. Same operator. Annals of Surgery. St. Louis, 1890, ii p. 324. Patient, female, 32 years of age. Equino-varus, right, extreme Dec. 26, 1887, two wedges removed, section of deltoid and astragalus, scaphoid, ligs. and plantar fascia and muscles after Phelps. Wound healed rapidly, and by Jan. 16th foot in excellent position. Walks with difficulty. Thomas club-shoe and plaster-of-Paris support. Tenotomy had been done frequently when a child; septicæmia set in and temperature reached 106°. Fistulæ in both feet and pieces of bone discharged. Now an organist, but sole of feet very tender.

180. Same operator and reference. Same patient. Equino-varus, left, extreme. Feb. 22, 1888, removal of wedges. Healing by first intention.

181. Same operator and reference. Patient a boy. Double equino-varus. May 16, 1886, operation, and other foot six months later. Walks in ordinary shoes. Good recovery and excellent shape.

182. Same operator. Boston Med. and Surg. Journ., 1890, p. 278. Patient 8 years of age. Equino-varus. V-shaped section of the tarsus. Deformity corrected. Five months later foot in good position; sinus remained, but healed after a spicule of bone came away. Ankle-joint motion fair.

183. Dr. Gillette. Not published. Patient 11 years of age. Equino-varus. Excision of head of astragalus and section of tendo Achillis and plantar fascia. Foot in fair position; suppurating wound. One year later foot quite flat. Slight ankle-joint motion. Child had scarlet fever one week after operation, which probably delayed healing.

184. Same operator. Patient about 11 years of age. Equino-varus. Scars from previous operations. Excision of head of astragalus. Six months later foot in good position; sole fairly on ground. Plaster-of-Paris support. Ankle-joint motion very slight.

185. Dr. Goldschmidt. Not published. Severe equino-varus. Excision of cuboid and astragalus. Three years later, walked lame and with marked hollow in foot, but no pain.

186. Dr. H. E. Goodman. Not reported. Patient 12 years of age. Equino-varus, left; equinus not marked. About Dec., 1891, excision of astragalus. Varus corrected; instep quite arched, and sole quite hollow. Eight months later, useful foot and no pain; marked arching of instep. Braces used. Ankle-joint motion about 10° or 15°.

187. Dr. Nich. Grattan. Brit. Med. Journ., Lond., 1891, i. 964. Patient 6 years of age. Equino-varus, right; foot rests flat on the ground; equinus not marked. Operated upon; did well. Prevents tendency to relapse by elastic cord secured by adhesive plaster.

188. Same operator and reference. Patient 6 years of age. Equino-varus, left; same as above. Osteoclasis of tibia and fibula close to ankle-joint and at junction of middle and lower thirds. Ten days later leg put in a corrected position. Six weeks later fracture united; foot flat on the ground, but inverted. Posterior iron splint support.

189. Same operator and reference. Patient, male, 9 years of age. Equino-varus, right, severe. March 19, 1892, excision of astragalus. Recovery good. Ankle-joint motion. Refused further treatment.

190. Same operator and reference. Same patient. Equino-varus, left, severe. July 4, 1892, excision of astragalus. Recovery good.

191. Same operator and reference. Patient, male, 1½ years of age. Equino varus, right. July 21, 1892, excision of astragalus. Wound healed. April 20, 1893, position good, but tendency to relapse. Rubber muscle supports. Ankle-joint motion.

192. Same operator and reference. Same patient. Equino-varus, left. Nov. 18, 1892, excision of astragalus. Wound healed. Ankle-joint motion.

193. Same operator. Patient, male, aged 2 months. February 11, 1893, osteoclasis, section of tendo Achillis. Under treatment. Plaster-of-Paris.

194. Same operator. Patient, male, 8 years of age. Club-foot, right tenotomy several times without success. August 18, 1889, excision of astragalus. Very good results. Walking power very good. Good ankle-joint motion. Osteoclasis done November 18, 1890; January 31, 1891; April 4, 1891.

195. Same operator. Same patient. Club-foot, left. August 18, 1889, excision of astragalus. Very good results. Walking power very good. Good ankle-joint motion.

196. Same operator. Patient, female, 10 years of age. Club-foot, left. September 1, 1890, excised astragalus. January, 1893, tendency to relapse. Perfect ankle-joint motion. Osteoclasis December 2, 1890.

197. Same operator. Patient, female, 2½ years of age. Equino-varus, right. March 1, 1890, excision of astragalus. Good results. Good ankle-joint motion. Osteoclasis January, 1891.

198. Same operator. Same patient. Equino-varus left. March 1, 1890, excision of astragalus. Good results. Jan., 1893, walking very good. Good ankle-joint motion. Osteoclasis, Feb. 26, 1892.

199. Same operator. Patient, male, 3 years of age. Equino-varus, left. March 9, 1891, excision of astragalus. Good recovery. April 1, 1893, recovery good; walks fairly well; sent home. Ankle-joint motion good. May 19, 1891, osteoclasis, and again Jan. 28, 1893.

200. Same operator. Same patient. Equino-varus, right. June 7, 1891, excision of astragalus. Good recovery. Good ankle-joint motion. Aug. 27, osteoclasis, and again Jan. 28, 1893.

201. Same operator. Patient, female, aged 6 months. Equino-varus, left. June 21, 1891, osteoclasis. Recovery good. Plaster-of-Paris supports.

202. Same operator. Same patient. Equino-varus, right. June 28, 1891, osteoclasis. Recovery good. Plaster-of-Paris supports. Died April 11, 1892, of measles.

203. Same operator. Patient, male, 2 years of age. Equino-varus, right; tenotomy and forcible rectification; failure. June 21, 1891, osteoclasis of leg above ankle. Recovery good. Nov. 10, 1892, walking about without assistance. Metal back splint.

204. Same operator. Same patient. Equino-varus, right; tenotomy and forcible rectification; failure. Aug. 11, 1891, excision of astragalus. Nov. 10, 1892, walking about without assistance. Metal back splint.

205. Same operator. Patient 2½ months of age. Equino-varus, right, Aug. 29, 1891, osteoclasis of the leg. Position good. Sept. 14, taken home to-day suffering from an attack of diarrhœa. Plaster-of-Paris support.

206. Same operator. Same patient. Equino-varus, left. July, 1891, osteoclasis. Position good. Plaster-of-Paris support Died Oct. 2, 1891.

207. Same operator. Patient, male, 12 years of age, equino-varus, left. July 17, 1891, osteoclasis. Position good. Recovery good. Plaster-of-Paris support.

208. Same operator. Patient, male 3 years of age. Equino-varus right. Oct. 29, excision of astragalus; May 23, 1891, osteoclasis. Wound healed. Recovery good. Braces.

209. Same operator. Patient, male, 3 weeks old. Equino-varus, right. Aug. 18, 1891, osteoclasis. Shape good. Recovery good.

210. Dr. Frank Hartley. Bost. Med. and Surg. Journ., 1890 (122) p. 270. Patient, male 21 years of age. Equino-varus, left, congenital; increased between 6 and 12 years; ⅔ normal motion at ankle; neck of astragalus twisted very badly, and os calcis obliquely to tibia. June 5, 1889, excision of wedge at ankle from tibia and fibula, all of astragalus, part of cuboid, scaphoid, and os calcis. Healing normal. Allowed to walk in wards by middle of October; discharged Nov. 29th. Braces.

211. Same operator. Same patient. Equino-varus, right; same as left. Sept. 25, 1889, same operation as on left. Aug. 24th, union fairly good. Good recovery. Braces. Muscles regaining size and strength; crutches used only for long walks, and will be given up in one to two months, and retention apparatus can be then taken off.

212. Dr. T. W. Holmemann, Surg. to Hosp. for Children in Copenhagen. Dr. P. Lorenzen, On the Treatment of the Higher Degrees of Congenital Varus. Kjobenhavn, 1887. Patient 6 years of age. Marked deformity of right foot. Rigidity of, and excoriations of the foot. May 6, 1883, excision of astragalus and process of calcaneum and external malleolus. Foot slightly supinated and adducted. Three years later walked on outer border of foot. Scarpa's shoe.

213. Same operator and reference Patient 5 years of age. Equino-varus, right. Rigidity. July 9, 1885, excision of astragalus, external malleolus, upper surface of calcaneum, and os naviculare. Good position; forefoot but slightly adducted. One year after, function better, adduction still exists; hyperostosis of tarsals. Shoes modelled for the foot. Ankle-joint motion slight.

214. Prof. Holmer. Dr. P. Lorenzen, Am Behandling of den Medhodt Klumphods hoier grades, Kjobenhavn, 1887 (On the Treatment of the Higher Degrees of Congenital Talipes Varus). Patient 12 years of age. Equino-varus. Rigid deformity. May 10, 1878, cuneiform osteotomy; Esmarch's bandage. Correction almost complete. Gangrene set in and amputation was done.

215. Same operator and reference. Patient 5 years of age. Equino-varus, right. Rigidity. July 29, 1880, cuneiform osteotomy. Almost natural position. Six years later position almost as bad as before the operation. Modified Scarpa's shoe with rubber muscles. Very little ankle-joint motion.

216. Same operator and reference. Patient 11 years of age. Equino-varus, left. Feb. 17, 1880, cuneiform osteotomy. Heel could not be completely brought down, and incurvation of plantar not quite removed. Six years later slight incurvation of forefoot; heel not completely down. Modified Scarpa's shoe with rubber muscles. Very little ankle joint motion.

217 Patient 12 years of age. Left equino-varus, marked. Rigidity. March 3, 1880, cuneiform osteotomy. Almost natural position obtained. Two years later foot well formed, function good. Modified Scarpa's shoe with rubber muscles. No considerable ankle-joint motion possible.

218. Same operator and reference. Patient 6 years of age. Left equino-varus marked. Rigidity. March 23, 1880, cuneiform osteotomy. Almost natural position obtained. Two years later foot nearly as bad as before. Scarpa's shoe.

219 Same operator and reference. Patient 17 years of age. Right equino-varus, marked. April 31, 1880, cuneiform osteotomy. Almost natural position obtained. Two years later position as good as just after operation. Ankle-joint motion to almost natural extent.

220. Same operator and reference. Patient 15 years of age. Equino-varus, left. Sept. 15, 1880, cuneiform osteotomy; Esmarch's bandage.

221. Same operator and reference. Same patient. Equino-varus, right. Nov. 9, 1880, excision of astragalus and cuneiform osteotomy. Died on Nov 12, 1880, of carbolic acid poisoning.

222. Same operator and reference. Patient 4 years of age. Equino-varus, right. Rigidity. Nov. 23, 1880, cuneiform osteotomy. Almost natural position obtained. Two years later deformity considerable. Plaster-of-Paris bandage.

223. Same operator and reference. Same patient. Equino-varus, left Rigidity. Jan. 15, 1893, cuneiform osteotomy. Almost natural position obtained. Two years later deformity considerable. Plaster-of-Paris bandage.

224. Same operator and reference. Patient 6 years of age. Equino-varus, left, marked. Rigidity. May 17, 1881, cuneiform osteotomy. Good position. Three years later amputation—mod. Syme. Scarpa's shoe.

225. Same operator and reference. Patient 13 years of age. Equino-varus left. Feb. 10, 1882, cuneiform osteotomy. Very good position. Three and a half years later function very good. Metal braces. Ankle-joint motion very good.

226. Same operator and reference. Patient 12 years of age Equino-varus, right. Sept. 10, 1881, cuneiform osteotomy. Almost natural position.

227. Same operator and reference. Same patient. Equino-varus, left. March 8, 1882, excision of astragalus and pros. ant. calcaneum. Good position. Four years later she was walking on outer border of feet, the feet forming stiff bony masses. Metal braces.

228. Same operator and reference. Patient 3 years of age. Equino-varus, right. April, 18, 1882, cuneiform osteotomy. Good position.

229 Same operator and reference. Same patient. Equino-varus, left. March 13, 1884, cuneiform osteotomy. Good position. Natural position and good function of both feet. Scarpa's shoes. Very little ankle-joint motion.

230. Dr. Hueter. Patient, male. Equino-varus. Removal of astragalus and scaphoid. Good results.

231. Prof. A Iversen. Dr P. Lorenzen, Am Behandling of dem medhoit Klumphod hoier grades. Kjobenhavn, 1887 (on the treatment of higher grades of congenital varus. Patient 5–6 years of age. Equino-varus, left. 1883, excision of astragalus; 1884, cuneiform osteotomy Not very good position. Two years later very good position.

232. Same operator and reference. Patient 4 years of age. Equino-varus, right. 1884, excision of astragalus. Incomplete correction; some adduction and supination of forefoot. Two years later forefoot adducted and supinated, function poor. Shoes modelled to the deformity. Ankle-joint motion slight.

233. Dr. M. Jalaquier. Bull. et Mém. de la Soc. de Chir. de Paris, 1890, xvi pp. 67–68. Patient 5 years of age. Equino-varus, right, paralytic; equinus more marked. June 22d, excision of astragalus, cuboid, Anon's section of tendo Achillis and plantar fascia. Iodoform eczema very violent on July 14th, and lasting about one month. Healing complete after removal of small cartilage which caused a fistula.

234. Same operator and reference. Same patient. Equino-varus, left. June 22d, excision of astragalus. Completely healed by June 29th. Very good results. Braces. Left hospital Oct. 20th; normal articulation; no lateral motion; step firm and painless. Very satisfactory; the astragali were very peculiarly deformed; the neck hypertrophied, was raised up; body pyramidal and directed backward; transverse diameter one-third greater in front than posterior, the latter being lessened by pressure of malleoli. Bony wedge pointed out by M. Nélaton is seen slightly.

235. Same operator and reference. Patient 12 years of age. Talipes valgus, right, paralytic origin. July 18th, excision of scaphoid, section of peroneals behind the malleoli, and tenotomy of tendo Achillis. July 26th, union perfect; got up at beginning of September. Oct. 1st, left hospital with everything in good place. At end of November walked four kilometres without pain; everything in good condition. Braces.

236. Dr. C. N. D. Jones. N. Y. Med. Journ., 1891, pp. 53–404. Patient, female, 11 years of age. Equino-varus, double congenital. Nov. 1888, wedge of bone excised from cuboid in each foot. Nov. 29, 1890, resection of tarsus after Davies-Colley. Four weeks later feet in good position and wound healed. Water-glass and plaster splints till early in 1889. On Feb. 29, 1888, Phelps' open incision was made on both feet and forcibly rectified. She disappeared for several months, and feet relapsed. Inversion and fixation, then operated on Nov. 1888.

237. Dr. Kirmisson. Bull. et Mém. de la Soc. de Chir. de Paris, 1891, xvii. pp. 510–511. Patient 8 years of age. Equino-varus, right, congenital; foot at acute angle with axis of leg; astragalus

completely subluxated. Feb. 24, 1891, Phelps' operation (three tenotomies of tendo Achillis had been done previously). Perfect restoration of foot.

238. Dr. Daniel La Ferte. Harper Hospital Bulletin, 1891 ii. p. p. 39. Patient 5 years of age. Equino-varus, double congenital, severe. Nov. 9, 1889, excision of cuboid and section of tendo Achillis; Jan. 20, 1890, tendo Achillis again cut. Treatment continued several months; very good results. Tenotomy twice without success.

239 Dr. Le Bec. France Médicale, 1889. Patient 13 years of age. Equino-varus. March 22, 1888, excision of astragalus and scaphoid with section of tendo Achillis, tibialis anticus, and plantar fascia. Good union by first intention. Nine months later walks well, leg shorter, foot flat on the ground. Braces. Ankle-joint motion. Astragalus and scaphoid were ankylosed.

240. Same operator (not published). Patient 14 years of age. Equino-varus, right. Oct. 20, 1888, excision of astragalus and scaphoid. Two months later walks well, foot straight and flat. Braces. Ankle-joint motion limited.

241. Same operator Same patient. Equino-varus, left. Oct. 20, 1888, excision of astragalus and scaphoid. Suppuration for four weeks. Two months later walks well, foot straight and flat. Braces. Ankle-joint motion limited.

242. Same operator. Paris Thèsis, 1889–90. H. Le Marc'hardam. Patient, female. Excision of astragalus and scaphoid, and section of tendo Achillis, tibialis anticus, and plantar fascia. Good result.

243. Dr. Le Dente. Paris Thèsis (cites Bull. de la Soc. de Chirurg.). Patient 30 years of age. Equino-varus severe. Excision of astragalus, cuboid, ant. ext. angle of os calcis, and post. int. angle of scaphoid. Very satisfactory result.

244. Same operator. Bull. et Mém. de la Soc. de Chir. de Paris, 1887, xiii. p. 728 (disc. on paper of Duret). Patient 7 years of age. Equino-varus. Excision of astragalus and cuboid and part of calcaneum. Some ankle-joint motion.

245. Dr. Lenger. Ann. de la Soc. Méd.-Chir. de Liége, 1890. xxix. pp. 165–66. Patient 11 years of age. Congenital varus, left, calcaneum elongated and its exterior surface curved inward; the trochlea of astragalus almost entirely outside the tibio-fibular sheath, scaphoid against the inner malleolus. Jan. 15, 1890, excision of astragalus and ant. 2 cm. of calcaneum. Healed within a month. Perforated zinc splint applied over dressings until healing was complete. Articulation free, especially after so extensive a bony resection. Dr. Lenger does not think that equino-varus can be arrested without extirpation of the astragalus.

246. Same operator and reference. Same patient. Congenital varus, right. Feb. 5, 1890, excision of astragalus and ant. 2 cm. of calcaneum. Healed within a month. Perforated zinc splint applied over dressings and healing was complete. Articulation free, especially after so extensive a bony resection.

247. Dr. Lucke. Patient, male, 15 years of age. Congenital varus, single. 1881, excision of astragalus. Good results.

248 Dr. Lund. Lancet, 1878, i. p. 349. Patient, male, 7 years of age. Equino-varus, left, severe. May 7, 1872, excision of astragalus. Wound healed by thirty-eighth day. Four months later walks comfortably with apparatus. Rectangular splint, elastic traction; on sixty-eighth day Barwell's elastic ties applied. Slight ankle-joint motion. Tenotomy at six months; apparatus failure.

249. Same operator. Paris Thèsis, 1889–90, H. Le Marc'hardam (cites Chanod as above, see *D* (26) ante). Patient 29 years of age, Equino-varus, congenital. Removal of astragalus and section of aponeurosis plantaris and tib. ant. tendon. Result bad. Patient walked with a brace, but had pain in so doing.

250, 251. Same operator. Brit. Med. Journ., Oct., 1872. Patient, male, 7 years of age. Right and left equino-varus, congenital. Heels not on the ground. May 17th, excision of astragalus. Wound healed on thirty-eighth day. July 16th, Barwell's system applied; Sept. 30th, Sayre's shoes applied; rectangular splints just after operation. August 1st, considerable ankle-joint motion. Tenotomy at six months; under treatment four months and wore apparatus until thirteen months old. Wore shoes nearly one month, and walks without help.

252. Dr. C. W. MacGillivray. Trans. Clin. Soc. London, and Edinburgh Med. Journ., 1884–85. Patient, male, 6 years of age. Equino-varus, left. Tendons and fascia tense. Removal of cuboid, os calcis, and ext. cuneiform; second operation in same place removed truncated wedge. Healed rapidly; perfect position after second operation; boy walks with ease on sole of foot in six weeks after. Foot shortened and tendo Achillis on inner side, though quite mobile at meso-tarsal articulation. Suitable splint. Internal displacement decidedly improved; anterior part still points downward.

253. Dr. F. Margary (his obs. No. 2). Bull. et Mém. de la Soc. de Chir. de Paris, 1890, xvi. p. 89. Cites Margary, Sulla cura operativa del Pied Vara congenito inveterato, Milan, 1884. Patient 14 years of age Equino-varus, double congenital, extreme. Curvature marked, contraction of plantar fascia, tibial muscles and tendo Achillis, motion at ankle-joint limited, marked atrophy of muscles of calf. Jan. 15, 1884, excision of astragalus, scaphoid, cuboid, section of tendo Achillis and tibialis anticus and plantar fascia, superficial and deep, and removal of part of the skin on upper surface of foot. Healing rapid, cicatrix, partly by first and partly by second intention. May 18, patient discharged in good condition; free motion in leg, and foot altogether corrected of deformity. Braces. The result both as to form and functionating power astonished surgeons who examined it.

254. Dr. Marzo Marzocchi. Archivio di Ortopedia, Milan, 1892, vol. ix. p. 119. Patient 13 years of age; Equino-varus, right. Muscles somewhat atrophied, but responded to volition and electricity. Nov. 4, 1891, Phelps' method; later (date not given) excision of astragalus. Twentieth day, foot tends to deformity, and position of astragalus called for another operation; thirty days after second operation, perfect curve movements of flexion and extension; allowed walking very easily. Ankle-joint motion.

255. Same operator and reference. Same patient. Equino-varus left. Muscles somewhat atrophied, but responded to volition and electricity. Dec. 4, 1891, excision of astragalus and external malleolus and tenotomy of tendo Achillis. Excellent position, short foot, normal shape; no pain from motion at ankle; fortieth day, perfect cure. Ankle almost as free as natural joint.

256. Same operator and reference. Patient 14 years of age. Equino-varus, paralytic, extreme; no motion at astragalean articulation. Atrophy of muscles. Excision of astragalus and tenotomy of tendo Achillis. Fortieth day, with massage, considerable motion at talo-tarsean articulation; flexion and extension. Walking easy and rapid. Braces.

257. Dr. Mason. N. Y. Med. Record, 1887, n. 446. Patient, female, 20 years of age. Equino-varus, left, severe; plantar fascia divided previously. 1887, excision of astragalus with ext. malleolus. Hemorrhage in two weeks from foot; tibial amputation. Plaster dressing. Death in three weeks from blood poisoning.

258. Herr Mensell. Verhandl. d. Deutsch. Gesellsch. f. Chir., Berlin, 1878 (7) pp. 1–77. Patient, male, 12 years of age. Equino-varus, double, congenital, severe. April, 1877, excision of wedge of tarsus; other foot operated upon in the fall. Muscles of leg grew stronger; good recovery. Slight ankle-joint motion. Tenotomy had been done in infancy, and good result secured, but neglect allowed a relapse, and boy was unable to walk.

259. Monnier. Journ. de Médecin, Paris, 1892, 2 s. p. 337. Patient, boy, 5 years of age. Equino-varus. Ablation astragalus. Varus corrected; equinus remained. Entire correction. Braces for eight months. Complete flexion and extension.

260. Same operator. Ibid., 1893, 2 s. p. 177. Patient, boy, 14½ years of age. Equino-varus. Ablation astragalus. Correction. Absolute ankylosis. Braces.

261. Dr. L. Monnier, Surg. to St. Joseph's Hospital, Paris. Journ. de Méd. de Paris, vol. iv. 2 s. n. 28, pp. 337–339. Patient 3 years of age. Equino-varus left, congenital. Atrophy of muscles of leg. June 10, 1891, excision of astragalus and small part of scaphoid, with tenotomy of tendo Achillis. Eighteenth day, good position; foot in an apparatus; July 25th, slight pressure on the sole of the foot obtains perfect position of foot March, 1892, could walk all day without fatigue; foot well placed on the ground; good functional ankle-joint. Braces.

262. Same operator and reference. Same patient. Equino-varus, right, congenital. Atrophy of muscles of leg. Tenotomy sufficed. Wound healed by eighteenth day; apparatus kept on all the time; complete restoration hard to obtain. March, 1892, could walk all day without fatigue; foot well placed on the ground; good functional ankle-joint. Braces. Two engravings showing feet before and after operation.

263. Dr. J. E. Moore. Med. Record, March 17, 1891. Patient 28 years of age. Equino-varus. Ulcer on side of foot. For operation see reference. Walks easily with foot in good position. Two years later foot in excellent position. Ankle-joint motion limited.

264, 265. Same operator. Not published. Patient 9 years of age. Equino-varus, right and left. Phelps' operation, and wedge-shaped piece from outer side of tarsus Good position; uses crutches. Six months later patient "first-rate." Ankle-joint motion limited. Dr. Moore has rarely found bone operations necessary, but thinks results would have been better, in some cases, if he had operated, and will do more of them in the future.

266. Same operator. Patient 6 years of age. Equino-varus, right. Phelps' operation and wedge-shaped piece from outer side of foot. Normal position; patient could walk. One year later foot perfect. Good ankle-joint motion.

267. Same operator. Same patient. Equino-valgus, left. Removal of wedge-shaped piece from inside of foot. Normal position; patient could walk. Supported arch of sole by filling up sole of shoe. Ankle-joint motion good.

268. T. S. K. Morton. Med. News, Phila., 1889 (54), 542. Patient, female, 19 years of age. Equino-varus, extreme. July 1888, excision of wedge of tarsus. Primary union; foot in excellent position; dressed in three weeks. Oct., 1888, walks in ordinary shoes without limp or discomfort. Right-angle tin splint.

269. Dr. T. G. Morton. Same reference. Patient 18 years of age. Equino-varus, right and left. Legs poorly developed. Excision of cuboid, external and middle cuneiform, and part of scaphoid. Primary union, perfect result, useful and presentable feet. Tenotomy failed to correct deformity.

270. Same operator and reference. Patient, female, 5 years of age. Equino-varus, left. Excision of wedge of tarsus; division of tendo Achillis, tibial and long flexor of big toe. Perfect result. Now able to wear an ordinary shoe. One of five children, all of whom had club-foot. Parents robust and healthy, and no deformity in any part of family.

271. Same operator and reference. Patient, female, 12 years of age. Equino-varus, right, severe. Excision of wedge, and tenotomy. Three weeks later doing well. Dr. Morton thinks treatment of muscles after operation of great importance.

272. Same operator and reference. Patient, male, 14 years of age. Congenital equino-varus, left; outward displacement and rotation of astragalus, fibular articular process presenting subcutan. in central plane of leg. Right foot normal, 3¼ inches longer than left. Considerable atrophy. July 16, 1889, excision of astragalus; division of tendo Achillis. Aug. 11th, foot in excellent condition and position; wound healed except superficial ulcer; Aug. 13th, wound entirely cicatrized; Aug. 28th, able to walk Right-angle tin splint; Aug. 28th, braces applied. April, 1890, good ankle motion. Tenotomy at 9 years of age, no success; also wore braces several years. Aug. 11th, twenty-six days after operation, redressed for first time. Foot presents no tenderness. Excellent position of foot and limb; position normal.

273. Same operator and reference. Patient, male, 3 years of age. Double congenital equino-varus; left foot in worse condition, the astragalus being rotated through nearly half circle with its tibial articular surface subcutaneously. Aug. 22, 1889, excision of astragalus. Sept. 3, dressed; slight,

superficial wound; walks well, good motion, position of foot at right angle, May, 1890, left foot in excellent position. Right-angle tin splint with opening opposite heel. Unsuccessful tenotomy in infancy in both feet. Left foot, catgut drain and permanent dressing; no need to disturb dressing for several weeks.

274. Same operator and reference. Patient, male, 3 years old. Right foot greatly deformed now after tenotomy in infancy. Aug. 22d, excision of astragalus; open incision with extensive division of tendons. Sept 3d, dressed, wound closed. Right foot, some disposition to recurrence of varus. Excision of astragalus will soon be done.

275. Same operator and reference. Patient, male, 2½ years of age. Congenital equino-varus, left; astragalus markedly rotated, and its tibial articular surface subcutaneous. Sept. 27th, operation as above; excision of astragalus. Nov. 3d, dressed. April, 1890, position excellent; walks without lameness. Perfect cure.

276. Same operator and reference. Patient, female, 5 months. Double congenital equino-varus; astragalus of each foot was displaced forward and rotated; deformity very marked and tarsus rigid. Oct., 1889, excision of astragalus from each foot. Dressed twice: three weeks after operation was able to stand; ten weeks after walked without difficulty. April, 1890, position of feet good; walks with freedom. Formerly manipulation and stretching, but no good. Feb., 1889, under ether, feet were thoroughly stretched, but neither foot could be brought to right angle with the leg; tin splint applied, and removed each day. Massage and traction used. April 10th, again stretching, under ether, with apparatus, all to no benefit.

277. Same operator and reference. Patient 2 months old. Double congenital equino-varus marked; both feet the same. Flexion of feet greatly hindered by displaced astragalus. Oct. 24, 1889, excision of astragalus from each foot. Perfect rectification of position and motion. March, 1890, result in every respect satisfactory; flexion, extension, and position excellent. Oct. 20, 1887, manipulation, massage, apparatus, tenotomy. March, 1888, condition the same; marked equinus; tenotomy of Achillis and stretching; apparatus continued; Oct. 24, 1889, deformity increased, astragaloid equinus very marked.

278. Dr. T. G. Morton. Med. News, Phila., 1890 (57), p. 25. Patient, male, 16 years of age. Severe congenital talipes equino-varus, left. Marked atrophy of entire limb; ankle very rigid. April 19, 1890, excision of astragalus, division of tendo Achillis. Usual dressing; foot could be placed in normal position without tension. For many years had been without apparatus; manipulation, stretching, no result. Measurements: right thigh 15½, calf 11½, left thigh 10, calf 8½.

279. Same operator and reference. Patient, male, 4 years of age. Congenital talipes varus, right, marked; unable to flex foot; astragalus displaced; weak ankles, and slight valgus of left foot. Incurvation of knee; tendo Achillis rigid. Feb. 22, 1890, excision of astragalus, division of tendo Achillis. Dressed on 5th and 23d day when union was firm; perfect position and good motion. April, 1890, result most satisfactory as to position and motion. Good ankle motion. No family history of deformity. Unsuccessful treatment three years by massage and apparatus. In Feb., 1886, when only three months old, above treatment.

280. Same operator and reference. Patient, male, 15 months old. Congenital double equino-varus; right varus and equinus marked. Impossible to flex either foot to right angle; astragalus displaced and subcutaneous. March 22, 1890, excision of astragalus, division of tendo Achillis. Feet brought to perfect position. Present condition most satisfactory; has been able to walk for several weeks. Right-angle tin splint. Daily stretching.

281. Same operator and reference. Same patient. Left more severe equino-varus, otherwise condition same as in right foot.

282. Same operator and reference. Patient, male, 5 years of age. Double congenital equino-varus, marked. March 10, 1889, tarsectomy and open incision, division of tendo Achillis, ant. and post. tibials and plantar fascia. March 22, excision of astragalus in each foot, the bones were found quite ant. to tibia and rotated. May 1st, discharged in apparently fair condition After the excision the feet could without difficulty be placed at right angles with leg. April 27th, position of feet perfect. May 10th, walks without apparatus and with ordinary shoes; limbs straight; feet turned out. Right-angle tin splint. Ankle motion. May 1st, directed to wear braces and continue stretching. March 20, 1890, readmitted with aggravated equino-varus; tarsus rigid; astragalus cause of deformity; very limited amount of joint flexion; unable to stand alone.

283, 284. Same operator and reference. Patient, female, 7 years of age. Double congenital equino-varus; deformity excessive; walks on cuboid bones; great contraction of all soft parts, including sole and inner side. Thighs, legs, and feet markedly atrophied and spindle shaped; thighs and leg bones small, feet more solid and deformed than ever known at such an age; ankle-joints apparently ankylosed. April 26th, right foot tarsus were so dense and distorted and so firmly wedged that with great difficulty could the articula be identified: removal of astragalus, cuboid, ext. cuneiform, part of scaphoid necessary to bring foot to right angle with leg, also division of tendo Achillis, plantar fascia, flex. tendons of toes. May 12th, doing well; has not been dressed since operation; feet in excellent position. Right-augle tin splint. Tenotomy operation in infancy unsuccessful; general health good; no family history of deformity; weight 46 lbs.; no treatment in past three years. The wasting and contraction of soft parts on inner side of sole did not impede rectification. In all cases, limbs were kept elevated for several days. Primary union—primary dressing not disturbed before end of third, generally in fourth week. Shortly after first month, the child should be encouraged to walk, when the tin splint must make way for the ordinary talipes walking shoes with high heels.

285. Same operator and reference. Patient, male, 16 years of age. Double congenital equino-varus; walks on dorsa of feet. Legs poorly developed. Oct. 31st, excision of cuboid from right foot. Dec. 2d, excision of left cuboid by Thos. S K. M.; foot brought in position. Good position; primary union; result perfect. For some months wore braces, then abandoned them, since which time he wears ordinary shoes; feet are perfect. Had never been operated on Oct. 9th, tenotomy of all resisting structures in left foot (best foot), put it in good position as possible and placed in right-angle tin splint. Result not favorable.

286. Same operator. New England Med. Monthly, Bridgeport, 1887, vii. Equino-varus, double. Excision of cuboid in each foot. Cured.

287. Same operator and reference. Patient 17 years of age. Equino-varus marked. Rigidity. Excision of cuboid. Union by first intention. Well padded right-angle splint. Walked at end of fourth week in ordinary club-foot shoe. Condition perfect. Can use common laced shoes without steel supports easily.

288. Same operator and reference. Same patient Excision of astragalus. Entire correction 16 months later. Ankle motion.

289. Same operator. Med. News, Phila., 1889 (54), 542. Patient 4 years of age. Equino-varus, left. Feb 13th, excision of wedge. Dressed in three weeks. Solid union and excellent position.

290. Same operator and reference. Same patient. Equino-varus, right. March 21st, excision of wedge, also tenotomy and open incision on inner aspect of foot. Dressed at end of fourth week. Solid union and excellent position.

291. Same operator and reference Patient 4 years of age. Equino-varus, right Cuneiform osteotomy and tenotomy. Dressed in three weeks.

292. Same operator and reference. Same patient. Equino-varus, left Cuneiform osteotomy and open incision on inner side of foot. Dressed in three weeks. Both feet perfectly restored in shape and utility.

293. Same operator. Patient 4 years of age. Equino-varus. June 14, 1890, excision of astragalus. Good position and motion. Braces. Ankle motion, both feet.

294. Same operator. Patient 17 months old. Equino-varus. Oct. 2, 1890, excision of astragalus. Good position and motion. Braces. Ankle motion, both feet.

295. Same operator. Patient 17 years of age. Equino-varus. Oct 16, 1890, excision of astragalus. Good position and motion. Braces. Ankle motion, both feet.

296. Same operator. Patient 4 years of age Equino-varus, right. Nov. 16, 1890, excision of astragalus. Good position and motion. Braces. Ankle motion.

297. Same operator. Patient 6 years of age. Equino-varus, left. April 23, 1892, excision of astragalus. Good position and motion. Braces. Ankle motion.

298. Same operator. Patient 7 years of age. Equino-varus, right. March 14, 1891, excision of astragalus. Good position and motion. Braces. Ankle motion.

299. Same operator. Patient 19 years of age. Equino-varus, left. Oct. 29, 1891, excision of astragalus. Good position and motion. Braces. Ankle motion.

300, 301. Same operator. Patient 11 years of age. Equino-varus, right and left. Jan. 28, 1892, excision of astragalus. Good position and motion. Braces. Ankle motion. Dr. Morton thinks that if, after removal of astragalus, good position does not obtain, it is well to take out cuboid and external cuneiform in whole or in part, at all events get foot straight.

302. Same operator. Patient 14 years of age. Equino-varus, right. May 11, 1892, excision of astragalus. Good position and motion. Braces. Ankle motion,

303, 304. Same operator. Patient 20 months old. Equino-varus, right and left. Dec. 1, 1892, excision of astragalus. Good position and motion. Braces. Ankle motion.

305. Dr. Herman Mynter. Buffalo Med. and Surg. Journ., 1889-90, (29), p. 417. Patient, male, 25 years of age Equino-varus. Ulcerated bunion. Oct. 12, 1889, excision of cuboid, 2d and 3d cuneiform, and 5th, 4th, and 3d metatarsals, tendons, and plantar fascias according to Phelps Good position; all healed in nine weeks. Walks without pain. Plaster-of-Paris dressing. If patient walked one week formerly, would have to stay in bed seven months to heal the ulcer. Discharged Dec. 18th, cured.

306. Dr Nélaton. Bull. et Mém. de la Soc. de Chir. de Paris, 1890, xvi. p. 61. Patient 8 years of age. Talipes equino-varus, right; foot makes angle of 40° with leg, and extreme of calcaneum rests on ground, axis of calcaneum nearly vertical and parallel to axis of leg; head and trochlea of astragalus form larger protuberance in front. Atrophy of leg muscles is considerable. July 12th, excision of head of astragalus, part of great apophysis of calcaneum, and tenotomy of tendo Achillis, and incision of Phelps on inner side of foot, well within a month.

307. Same operator and reference. Same patient. Equino-varus, left, same as above with prominence of icteroid projection of ant. lateral region of trochlea of astragalus sprung from its socket. Atrophy of leg muscles is considerable. July 29th, Phelps' incision; resection of head of astragalus and ant. part of calcaneum apophysis, with tenotomy of tendo Achillis. A month later excised articular surface of astragalus and trochlea (outer edge), and again cut tendo Achillis. Equinus persisted until after second operation (see below).

308. Same operator. Ibid., p. 61-71. Same patient (2 years later). Equino-varus, left: back part of foot nearly vertical, and front part curved on it at right angles. Dec. 26th, excision of ext. surface, head, and neck, and trochlea of astragalus, and 1 cm. of large apophysis of calcaneum, tenotomy of tendo Achillis, and setting in place the displaced cuboid. Successful.

309. Dr. Ollier. Paris Thèsis, 1889-90 (cites H. le Marc'hardam, Ollier Lyon Méd., Nov. 27, 1880). Patient 9 years of age. Equino-varus, double. Excision of astragalus, cuboid, and anterior part of calcaneum. Incomplete; slight varus remains. Massage previously, and section of tendo Achillis and plantar fascias.

310. Dr. G. Dalle Ore. Rivista Veneta di Scienza Medicala, Venice, 1887, vol. vi. p. 298. Patient 20 years of age. Equino-varus, left, marked. Aug. 12, 1887, excision of astragalus and subcutaneous section of tendo Achillis. Temporary brace removed after forty days, foot in excellent position, sole flat on ground, legs equal in length. Sufficiently free ankle motion. When a child patient sustained a dislocation of foot which was not reduced.

311. Dr Paci. Paris Thésis, 1889–90, H. le Marc'hardam (cites Martin, same place as 2d ser., June 7, 1887). Patient 9 years of age. Equino-varus, right, marked; foot much drawn up, and makes almost a right angle with leg, plantar fascia strongly drawn. Considerable atrophy of limb. Sept. 15, 1884, excision of astragalus and section of plantar fascia. March 23, 1885, walks well, but there is a tendency to drawing up the forefoot. Brace corrects this. May 15th walks good.

312. Dr. John H. Packard. Patient 22 years of age. Equino-varus, right. Atrophy of muscles. Dec. 24, 1890, excision of astragalus and division of tendo Achillis, tendons of ant. and post. tibials, plantar fascia, and tendons of flexors of toes. Entire rectification; foot slightly pushed forward. No recurrence; patient walks well and firmly eighteen months later. About six months later a reinforced boot.

313. Dr. Francesca Paroma. Annal. Universali di Med. e Chir., Milan, 1887, vol. cclxxix. p. 121. Patient age not given. Equino-varus, right. May 27, 1886, excision of astragalus, resection of ext. malleolus (subperiosteal), tenotomy of tendo Achillis and plantar fascia (Margary's method). At end of three months patient walking about with foot inclosed in a half boot, braced. Foot in good position. "The tendo articulations have movements sufficiently free."

314, 315. Same operator. Ibid., p. 123 et seq. Patient 10 years of age. Equino-varus, right and left; great toes of the two feet touched. Sept. 2, 1886, cuneiform osteotomy of mid-tarsal bones, excision of 1 cm. of malleolus with a wedge formed of bones of os calcis, cuboid, astragalus, and scaphoid (wedge being 3 cm. long and base 2 cm.), and tenotomy of tendo Achillis, tibialis anticus, and plantar fascia. By the end of October wounds were cicatrized, and a plaster bandage was then applied. Nov. 8, 1886, foot in good position and deformity well corrected; sufficient mobility. Ankle motion.

316. Dr. Roswell Park Patient 10 months old. Equino-varus, left, marked. Jan. 22, 1890, cuneiform tarsectomy. Results good. Not seen since. Braces.

317. Same operator. Patient 3 years of age. Equino-varus, right. March 3, 1890, cuneiform tarsectomy. Good results two years and a half later. Braces. Ankle motion.

318, 319. Same operator. Patient 7 months old. Equino-varus, right and left. Sept. 5, 1891, excision of astragalus, right; and cuneiform tarsectomy, left. Good results. Not seen since. Braces.

320. Same operator. Patient 2⅓ years of age. Equino-varus, right. Oct 10, 1891, astragalectomy. Good results. Not seen since. Braces.

321, 322. Same operator. Patient 4 months old. Equino-varus, right and left. Nov. 26, 1891, astragalectomy. Good results. Not seen since. Braces.

323, 324. Same operator. Patient 7 years of age. Varus, right and left. Nov. 19, 1892, astragalectomy, right; and excision of astragalus, piece of mid-tarsal, and os calcis, left. Good results. Not seen since. Braces.

325, 326. Same operator. Patient 1½ years of age. Equino-varus, right and left. Feb. 16, 1893, astragalectomy. Good results. Not seen since. Braces.

327. Dr. Patterson. Lond. Lancet, 1880, i. 47. Equino-varus, congenital, double. Removal of cuboid and astragalus. Successful.

328. Dr. A. M. Phelps. Med. Record, New York, 1890, p. 593. Patient 13 years of age. Talipes equino-varus. Linear osteotomy. Wound healed in four weeks. Plaster-of-Paris shoe. Tenotomy previously done. Perfect result after four months.

329. Same operator and reference Patient 8 years of age. Double talipes equino-varus, Linear osteotomy. Wound healed in four weeks. Plaster-of-Paris shoe. Perfect result means straight and useful feet either toeing straight ahead or with normal function fairly preserved.

330. Same operator and reference. Patient 15 years of age. Double talipes equino-varus. Linear osteotomy and cuneiform resection. Wound healed in four weeks. Plaster-of-Paris shoe. Perfect result.

331. Same operator and reference. Patient 17 years of age. Double talipes equino-varus. Linear osteotomy and cuneiform resection. Wound healed in five weeks. Plaster-of-Paris shoe. Perfect result.

332. Same operator and reference. Patient 10 years of age. Double talipes equino-varus. Linear osteotomy. Wound healed in four weeks. Plaster-of-Paris shoe. Perfect result.

333. Same operator and reference. Patient 9 years of age. Double talipes equino-varus. Linear osteotomy. Healed in five weeks. Plaster-of-Paris shoe. Perfect result.

334. Same operator and reference. Patient 22 years of age. Single talipes equino-varus. Linear and cuneiform osteotomy. Healed in five weeks. Plaster-of-Paris shoe Good result means in-toeing of foot with congenital defect in ankle-joint, tibia or muscle, but useful feet—walking on plantar surface.

335. Same operator and reference. Patient 31 years of age. Single talipes equino-varus. Linear osteotomy and removal of cuboid and scaphoid. Healed in five weeks. Plaster-of-Paris shoe. Perfect result.

336, 337. Same operator and reference. Patient 16 years of age. Double talipes equino-varus. Linear osteotomy, cuneiform resection, right; linear osteotomy, left. Healed in six weeks. Plaster-of-Paris shoe. Good result.

338. Same operator and reference. Patient 11 years of age. Single talipes equino-varus. Linear osteotomy. Healed in five weeks. Plaster-of-Paris shoe. Good result.

339. Same operator and reference. Patient 21 years of age. Single talipes equino-varus. Linear osteotomy and removal of cuboid and scaphoid. Healed in seven weeks. Plaster-of-Paris shoe. Good result. Slough from tight dressing.

340. Same operator and reference Patient 8 years of age. Double talipes equino-varus. Linear osteotomy. Healed in five weeks. Plaster-of-Paris shoe. Perfect result.

341. Same operator and reference. Patient 4 years of age. Single talipes equino-varus. Linear osteotomy. Healed in four weeks. Plaster-of-Paris shoe. Perfect result.

342. Same operator and reference. Patient 17 years of age. Single talipes equino-varus. Linear osteotomy and cuneiform resection. Healed in six weeks. Plaster-of Paris shoe. Good result.

343. Same operator and reference. Patient 5 years of age Double talipes equino-varus. Linear osteotomy. Healed in five week. Plaster-of-Paris shoe. Good result.

344. Same operator and reference. Patient 12 years of age. Double talipes equino-varus. Linear osteotomy. Healed in five weeks. Plaster-of-Paris shoe. Perfect result.

345. Same operator and reference. Patient 16 years of age. Single talipes equino-varus. Linear osteotomy. Healed in six weeks. Plaster-of-Paris shoe. Perfect result.

Eighteen osteotomies in all. In no case a sensitive scar, flat-foot, or paralysis. No considerable atrophy of muscles in limb. Motion of toes preserved in nearly all cases. In those with loss of motion, locomotion seemed to be as perfect.

346. Dr. M. Piechaud. Journ. de Méd. de Bordeaux, Dec. 22, 1889, vol. ix. No. 21, p. 213. Patient an infant. Equino-varus marked. Boeckel's operation: excision of astragalus and resection of external malleolus, part of scaphoid, os calcis, cuboid, and section of tendo Achillis, tibialis anticus, and lesser adductor of big toe. Very satisfactory; massage. Dec., 1889, cured. Plaster-of-Paris.

347. Same operator. Bull. et Mém. de la Soc. de Chir. de Paris, 1890, xvi. pp. 89, 98. Patient 2 years of age. Equino-varus, double. Ablation of cuboid. Feet well straightened. Satisfactory.

348 Same operator and reference. Patient 12 years of age. Equino-varus. Excision of astragalus, calcaneum, and scaphoid, and parts of cuboid and external malleolus. Some suppuration. Nine months later walks walks well, limps slightly.

349. Dr. Picque. Ibid., 1891. xvii. p. 92. Patient, age not given. Partial luxation of astragalus, following infantile paralysis. Extirpation of astragalus.

350, 351 Dr. Pilcher. M. E. Hospital, N. Y., 1890. Patient 22 years of age Equino-varus, right and left congenital, extreme. Excision of astragalus and cuneiform osteotomy of os calcis, of scaphoid and cuboid, section of contracted structures. Uncomplicated recovery. Very good six months later, feet strong and useful, and cure permanent. Plaster-of-Paris.

352. Same operator and reference. Patient, female, 14 years of age. Equino-varus, left; paralytic; braces for long time. Excision of astragalus, resection of cuboid and os calcis, and section of plantar fascia. Very good, but leg somewhat shortened. Plaster-of-Paris and steel braces.

353. Dr. Poinsot. Bull. et Mém. de la Soc. de Paris, 1880 (6), 455. Patient, female, 12 years of age. Equino-varus, left, acquired, severe. 1878, excision of cuboid, and tenotomy. Walks on sole; requires apparatus; foot straight. Metal splint. Tenotomy at two years unsuccessful.

354. Dr. C. T. Poore. N. Y. Med. Journ., 1886 (43), p. 555. Patient 10 years of age. Equino-varus, left, congenital. Rigidity. Cuneiform osteotomy. No pain; walks with slight limp. Ankle motion increasing.

355. Same operator. Annals of Surgery, St. Louis, 1887, v. pp. 207–210. Patient 10 years of age. Equino-varus, right, congenital. Rigidity extreme. Jan. 14, 1886, wedge removed. Wound closed in one month; use of foot disallowed for eight weeks. When discharged could walk with foot flat on floor. Plaster-of-Paris Slight ankle motion. Attack of scarlet fever during treatment. Division of tendo Achillis and forcible correction with Bradford's instrument twice before had failed to correct.

356, 357. Same operator and reference. Patient, male, 8 years of age. Equino-varus, left, congenital, os calcis normal, front foot turned at right angles to it. Right, the same. Always slight paresis of lower extremities. Dec. 25, 1885, cuneiform tarsectomy, left. Feb 6, 1886, same operation, right. Wounds closed in one week Walking easy, sole flat on ground, right. Tendency of whole foot to point inward. Plaster-of-Paris. Tendons had been cut; mechanical treatment used for three years; three attempts to correct with Bradford's instrument, but no success.

358. Same operator and reference. Patient 14 years of age. Equino-varus, left, congenital; foot had been corrected but relapsed. Feb. 26, 1886, V-shaped piece from os calcis and neck of astragalus. High fever after one week; foot swollen; wound blue and sloughy. Plaster-of-Paris. Died on twelfth day of septicæmia. Under treatment several years, and had worn braces all this time.

359. Dr. Paulo Postempski. Bulletin della Reale Academia Med. di Roma, 13th year, 1887, p. 289. Patient, boy about 17 or 18 years of age. Equino-varus, left, congenital; astragalus very prominent in lateral external region of foot, and scaphoid on inner surface. Atrophy of leg. 1886, excision of astragalus; Lund's operation as done by Margary. Wound healed on 35th day, and deformity corrected. March 27, 1887, after 35 days patient gradually abandoned all support and walked perfectly well save a slight limp due to atrophy of leg. Sufficiently ample motion in new joint.

360 Dr. David Prince. St. Louis Med. and Surg. Journ., 1888, vol. liv. Age and deformity not given. Tarsectomy. Plaster-of-Paris.

361. Dr. R. M. Pughe. Liverpool Med.-Chir. Journ., 1886. Patient, female, 11 years of age. Position of foot not stated. Nov. 7, 1885, removal of astragalus, cuboid, and scaphoid. Jan. 28th, walks with ease without apparatus; foot shortened. Talipes splint. Subsequently divided some contracted plantar bands.

362. Same operator. Ibid., 1888. p. 355. Patient, female, 9 years of age. Equino-varus, right, extreme. Considerable atrophy; small foot. June, 1881, resection of cuboid. Healed in a little over a fortnight. Relapse, and in March, 1882, excision of head of astragalus, withcomplete recovery. Wore Brinton's shoe two months after first operation. Tenotomy had been done several times.

363, 364. Dr. M. Quienu (cites from Thesis of Martin, 1888). Paris Thesis, 1889–90, H. le Marc'hardam. Patient 15 years of age. Equino-varus, right and left, congenital; astragalus opposes all reductive measures. Atrophy of muscles of leg and thigh; genu valgum. Jan. 5, 1885, excision of astragalus, right; March 1, 1885, excision of left astragalus. March 1st, equinus healed; some varus still exists. Good result, left. June 30th, went out cured, walked without apparatus, but walk irregular from genu valgum.

365, 366. Dr. Artur Raffa. Archivio di Ortopedia, Milan, 1886, vol. iii. pp. 445–47. Patient 13 years of age. Equino-varus, double congenital, excessive; the great toes of the feet approximated; in all the articulations the movements were limited. Atrophy of the muscles and "an enormous deposit of adipose connected especially at the lower third of the supra-malleolar region;" the feet were relatively small. Jan. 7, 1886, right foot, enucleation of the astragalus and the scaphoid, resection of the external malleolus, plantar aponeurotomy, and Achillo-tenotomy of both feet (subcut.). Jan 21, 1886, same operation on left foot. Fiftieth day, commenced to walk at first with the help of a crutch, later with a stick. April 1, 1886, discharged. Braces.

367. Same operator and reference. Patient 13 years of age. Equino-varus, congenital, left, grave; the patient walked supported solely on the head of the further metatarsals and upon the toes. April 15, 1886 (left foot), extirpation of the astragalus, resection of the external malleolus, Achillo-tenotomy (subcut.). A month later cured; normal position of the foot; movements of flexion and extension possible. Braces. Ankle motion.

368, 369. Same operator and reference. Patient 2 years of age. Equino-varus, double congenital. July 1, 1886, tenotomy of the tendo Achillis and cuneiform tarsectomy of right foot. July 1, 1886, identical operation on left foot. Aug. 1st, applied usual half boot; patient supports himself on his feet, and with help walked a few steps. Discharged (date not stated). Braces.

370, 371. Dr. Rawdon. Liverpool Med.-Chir. Journ., 1883, p. 355. Patient, male, 8 years of age Equino-varus, double congenital, extreme; never walked; very high arch of foot. Cuneiform osteotomy of head of astragalus ad cuboid. Recovery. Tenotomy done two years ago, and Scarpa's shoes with elastic traction fairly overcame deformity, but astragalus prevented thorough reduction.

372. Dr. Reclus. Bull. et Mém. de la Soc. de Chir. de Paris, 1887. p. 704 (disc. on paper of Duret). Patient a child. Equino-varus. Excision of astragalus with section of tendo Achillis and plantar fascia. A certain concavity at head of int. edge of foot remains.

373. Dr. J. C. Renton. Glasgow Med. Journ., 1889 (5) s. 31, p. 338. Patient 11 years of age. Equino-varus, left, acquired. Aug. 25th, excision of wedge of tarsus. Eight months later good result. All structures in sole and tendons had been divided in infancy with temporarily good results.

374, 375. Same operator and reference. Patient 7 years of age. Double equino-varus, left, relapsed, severe. Nov. 24, 1885, removal of astragalus, Phelps' operation. Two years later, plays football.

376. Same operator and reference. Patient 2½ years of age. Equino-varus, double, severe. Excision of astragalus ten days between operations. Eighteen months later tendency to relapse. Rectangular tin splint. Good ankle motion. Several operations had been done, but no success.

377. Prof. Richet. Bull. Méd., Paris, 1888, ii. 891. Patient 5 years of age. Equino-varus, double; feet rest on outer apophysis of calcaneum, June 25, 1888, excision of one astragalus and resection of anterior part of calcaneum, tenotomy of tendo Achillis. July 6th, good position, but suppuration of wound, and rear incisions for tenotomy. In operating on other foot, he will do tenotomy eight days before ablation of astragalus.

378. Dr. B. M. Ricketts. Journ. Amer. Med. Assoc., Chicago, 1892 (19), 219. Patient, male, 14 years of age. Equino-varus, right, congenital, severe; weight of body on astragalus, foot turned straight back. Sept. 2, 1891, excision of astragalus, section of tendo Achillis and plantar fascias. On crutches at end of four weeks. Left hospital at end of tenth week cured; wears shoes, no crutches. Position maintained by straps passed under foot close to toes, and made fast to hooks, woven in plaster, extending from middle of thigh to below knee. Left foot cured by manipulations; apparatus could not be worn.

379. Dr. Reid. Patient 4 years of age. Equino-varus, right, congenital; section of tendo Achillis was a failure. Oct., 1887, excision of astragalus and 1 cm. of fibula; five months later, section of tendo Achillis and plantar fascia. June 28, 1888, some varus remains.

380. Same operator. Paris Thesis, 1888–90, H. le Marc'hardam. Patient 14 years of age. Equino-varus, congenital. Jan., 1879, excision of astragalus and part of malleolus, with section of plantar fascia. In February severe pains in foot prevented walking, and kept patient in bed several weeks. Walks with a shoe and lateral splints.

381. Same operator. Deutsche Zeitschr. f. Chir., 1880 (13), p. 114. Patient, female 43 years of age. Equino-varus, left, acquired, severe. Rheumatic ankylosis. 1865, excision of astragalus and malleolus. Good results in four weeks. Good ankle motion. Fixation.

382. Same operator and reference. Patient, male, 44 years of age. Equino-varus, severe, acquired. 1875, excision of astragalus; straightening produced fracture. Treated for three months. Excellent result. Plaster.

383, 384. Dr. Sands (reported by Dr. A. K. Briddon). N. Y. Med. Journ., 1891 (53), p. 312. Patient, female, 4 years of age. Equino-varus, double. Sept. 20, 1890, wedge from tarsus. Oct. 25, 1890, cuneiform osteotomy, left. Allowed to walk in glass splints in 48 hours. Jan. 14th, splints removed, position perfect. Plaster-of-Paris. Glass splints over plaster in 48 hours. Previous tenotomy had partially corrected equinus.

385. Same operator. Ibid., 1888 (47), p. 158. Patient 12 years of age. Equino-varus, congenital, exaggerated Nov. 5, 1887, excision of cuboid, ext. and mid. and int. cuneiforms and parts of scaphoid and os calcis. Wound healed by Dec. 17th; slight plantar flexion remained. Splint removed Jan. 5th. Results noticed until Jan. 11, 1888. Plaster-of-Paris. Considerable ankle motion. Bony union not quite firm; Jan. 11th, slight equinus remained, which would have been overcome if astragalus had been removed.

386. Same operator and reference. Patient 6 years of age. Cuneiform tarsotomy and excision of astragalus. Union by first intention. Plaster-of-Paris. Good ankle-joint motion. Leg somewhat shortened.

387. Dr. Schede. Patient an infant. Equino-varus, congenital. Removal of parts of cuboid, astragalus, and scaphoid, and section of tendo Achillis. Good result.

388. Dr. Schwartz. Bull. et Mém. de la Soc. de Chir. de Paris, 1892, xviii. pp. 94–96. Patient 22 years of age. Equino-varus, paralytic; absence of response in muscles on ext. region of foot except

extensor longus pollicis pedis and lateral peroneals; contraction of tendo Achillis. Sept. 16, 1891, excision of head of astragalus, articular cartilage, and tendo Achillis; linear osteotomy of external malleolus. Began sitting up on sixtieth day. Feb. 3, 1892, walks easily, placing sole of foot flat.

389. Dr. Harry M. Sherman. Not published. Patient 18 years of age. Equino-varus, acquired. June 14, 1889, section of tendo Achillis and plantar fascia, and Thomas's wrench to straighten. Second operation Dec. 5, 1889, wedge-shaped piece removed from cuboid. Good and practically permanent result. Oct. 10, 1889, tendency to relapse. Plaster-of-Paris, Wyeth's night shoe, shoe with raised outer edge. Ankle motion. Died some months after operation; said to have died in a fit. Patient said to be an epileptic, but had no attacks while in hospital.

390. Same operator and reference. Patient 7 years of age. Varus, congenital. Previous treatment ineffectual. Aug 2, 1891, cuneiform osteotomy in cuboid. Thoroughly satisfactory; still under observation for scoliosis. Night shoe, shoe with outer edge of sole thickened. Ankle motion. Whole limb is smaller. Sole has to compensate shortening, as well as hold varus corrected.

391. Same operator and reference. Patient 9 years of age, Equino-varus, left. May 2, 1891, section of ligaments, fascia, and tendo Achillis, by Phelps' method. Could not obtain complete correction even with Thomas's wrench. Second operation June 27, 1891, excision of astragalus and cuneiform osteotomy of os calcis by Phelps' method. Thoroughly satisfactory position. Result permaneut. Modification of Wyeth's night shoe at night Varus shoe, *i. e.*, raised outer edge. Aukle motion.

392. Dr. Stephen Smith. N. Y. Med. Rec., 1879 (15), 491. Patient, female. Equino-varus, left, congenital. Excision of cuboid. Walking painful; Syme's operation fiually. Good recovery.

393. Dr. Solly. Lancet, 1857, i. 478. Patient, male, 22 years of age. Varus, left, congenital. 1854, excision. Required subsequent tenotomy; moderately successful; walks with ease three years later. Scarpa's shoe. Tenotomy had been done on both feet, and shoes worn for two years, with cure of right foot, but failure in left.

394. Dr. Ed. Springfeldt. Inaug. Dissert. on Treatment of Club-foot, Bonn, 1884, 8vo, p. 46. Patient 10 years of age. Varus, right; already had had tenotomy and orthopedic treatment. Rigidity marked. Sept. 8th, resection of cuboid, and on Nov. 1st tenotomy of tendo Achillis. Good cure, but dorsal flexion hindered by prominence of caput tali. Dec. 8th, foot rests flat on ground; some adduction still present. Mechauical apparatus. Refers to resection of Davies-Colley, No. 57.

395, 396. Dr. Ch. Steeg. Gaz. hebdomadaire de Méd. et Chir., Paris, 1889, 36th year, No. 52, Dec. 27. Patient, male, 14 or 15 years of age. Double varus. Jan., 1889, excision of astragalus and cuboid with section of plantar fascia. Satisfactory, foot firmly resting on heel and sole; slight incurvation, right foot. Dec. 27, 1889, excision of scaphoid and astragalus, left foot. Operator says: "This ablation of astragalus and scaphoid will probably be insufficient, and will compel me to remove the cuboid and the ant. part of os calcis, left foot. Braces.

397. Prof. Studsgaard. Dr. B. Lorenzen (On the Treatment of the Higher Degrees of Congenital Talipes-varus). Patient 3 years of age. Equino-varus. June 21, 1885, excision of astragalus and section of plantar fascia. Good position. Died short time after operation, of diarrhœa.

398. Same operator and reference. Patient 9 years of age (same as 142, 143). Equino-varus, left. Feb. 1, 1885, excisiou of astragalus and os naviculare on left foot, and resection of ext. maleolus. Good position. Third operation Sept. 1886, three years later; considerable deformity of both feet. Scarpa's shoe and night splint. No subsequent ankle-joint motion.

399. Same. Patient 13 years of age. Equino-varus, right. Aug. 21, 1881, cuneiform osteotomy. Good position and fnnction. Five years later good position and very good function. Modified Scarpa's shoe with rubber muscles. Ankle-joint almost natural.

400. Same operator and reference. Patient 1¼ years of age. Equino-varus, left. July 7, 1882, cuneiform osteotomy. Good position. Four years later almost as good as just after operation. Metal braces.

401. Same operator and reference. Patient 9 years of age. Equino-varus, right. Oct. 19, 1882, excision of astragalus. Good position; slight motion.

402, 403. Same operator and reference. Patient 3 years of age. Double equino-varus. July 3, 1884, excision of astragalus, right; good position. Aug. 21, 1884, excision of astragalus, left; good position.

404, 405. Same operator and reference. Patient 7 years of age. Double equino-varus, marked. Aug. 2, 1885, excision of astragalus with division of plantar fascia, adductor hallicis, tendon of extensor hallicis, and int. ligaments; good position. Fifteen months later, good function; walks on sole of foot; slight adduction of forefoot. Scarpa's shoe and night splint shoe, right foot. Aug. 2, 1885, excision of astragalus and division of ligaments between os naviculare and first cuneiform bone. Good position. Slight ankle motion, left.

406, 407. Some operator and reference. Patient 15 years of age. Double equino-varus. Rigidity. Sept. 30, 1885, excision of astragalus and os naviculare and section of plantar fascia and adductor hallicis. Good position. One year later, function good; slight adduction of forefoot. Scarpa's shoe and night splint. Slight ankle motion, right. Oct. 2, 1885, excision of astragalus and ant. proc. of calcaneum and division of plantar fascia. Good position, right.

408, 409. Dr. Terrillon. Bull. et Mém. de la Soc. de Chir. de Paris, 1887, xiii., p. 726 (disc. on paper by Duret). Patient 14 years of age. Double equino-varus, paralytic; complete reversal of feet inward and projection of astragalus. Legs thin and frail. June 7, 1887, extirpation of astragalus and subcutaneous section of tendo Achillis, right. July 15, 1887. same operation, right. Feet straight, slight raising of int. edge at first, but walking gradually lessened this deformity. Most satisfactory.

410, 411. Dr. L. Tiffany. Patient 5 years of age. Double equino-varus. Excision of astragalus. Great improvement. One year later soles of feet on ground; walked and ran with ease. Wore braces for ten months. Ankle motion. Tendo Achillis, tibial tendons, and plantar fascia had been cut some time before, and child had worn braces.

412. Dr. Trendelenburg. Inaug. Disc. on Treatment of Club-foot, 8vo, Bonn, 1884. Ed. Springfeldt. Patient 7 years of age. Varus, right, congenital, extreme; suppuration about heel, and twisting of axis of malleolus. July 5, 1884, excision of tarsus. Good position and result; no drainage. Plaster.

413. Dr. Verbelzi. Centralbl. f. Chir, 1877, 24. Patient, female, 5 years of age. Equino-varus, congenital, double. One foot operated on—subperiosteal section, excision of astragalus. Immediate straightening. Cure—straight foot. Plaster-of-Paris, apparatus later. Previous tenotomy, plaster dressings, and failure.

414. Dr. Verneuil. Patient, male, 36 years of age. Varus, acquired from bimalleolar fracture; severe. 1881, excision of astragalus; tibia and fibula shortened. Drainage. In two months walked with apparatus. Plaster.

415, 416. Dr. Vogt. Inaug. Disc. on the Treatment of Club-foot, 8vo, Bonn, 1884, 46. Patient 1¼ years of age. Club-foot, double, severe. May 4, 1885, excision of tarsus. Union by first intention. Good position; adduction of metatarsus, right. Plaster splints at night, left. Haltemann, Verwerthung und methode des extirpatio tali. Diss., Griefswald, 1883.

417. Same operator and reference. Patient, very small child. Club-foot. June, 1883, excision of tarsus. Three weeks, wound healed. Felt splint.

418. Dr. Volkmann. Patient, male, 6 years of age. Equino-varus, acquired. Excision of astragalus. Rapid cure. Walks with a cane.

419. Dr. Weinlechner. Aertzlicher Bericht. des k. k. Allg. Krankenhaus zu Wien, v. 1, 1882 (Wien, 1883) p. 251. Patient 35 years of age. Equino-varus, left, paralytic; rotation excessive; int. malleolus almost hidden; ext. malleolus very prominent, also head of astragalus. Paraplegia. Nov. 11, 1881, cuneiform osteotomy of astragalus and calcaneum, and on Dec. 1st, removal of remainder of astragalus, which had necrosed. Two weeks later phlegmonous inflammation of almost entire leg requiring multiple incisions. Later a severe attack of diphtheria. March 11, 1882, erysipelas for six days, and several abscesses on foot. Wound not healed until April 30, 1882. Condition improved, but reduction incomplete.

420. Dr. W. Weiss. Gaz. des Hôpit. aux Paris, 1885, 58th year, p. 251. Patient 18 years of age. Equino-varus, right, accidental; forefoot bent suddenly, sole inward, even with the tarso-metatarsal artic; partially luxated astragalus projects on back. Following myelitic atrophy of leg. April 3, 1884, tenotomy of tendo Achillis and section of plantar fascia. May 2, 1884, excision of astragalus (Boeckel's operation). Recovery slow. June 17th, slight suppuration. July 1st, began to use crutches; Aug. 1st, discharged from hospital prevented by hydrarthrosis of right knee. Good result, and everything satisfactory on March 1, 1885. Extension, motion; walking easy.

421. Dr. J. F. West. British Med. Journ., 1878, ii. p. 657. Patient, female, 23 years of age. Equino-varus, left, congenital; plantar fascia contracted, ungual phalanx of second toe overlapping big toe; pain on walking; contraction of tendo Achillis and tibialis anticus and and posticus. May 19th, removal of astragalus, cuboid, and scaphoid. Ten weeeks later useful limb. June 12th, ant. splint, and foot put in cradle. July 10th, gutta percha and splint. July 15th, inside gutta perch splint. Several abscesses formed on the foot from pressure of splints. Aug. 5th, wounds all healed, and light starch bandage put on and patient began walking.

422. Dr. James Whitson. Brit. Med. Journ., Lond., 1888, ii. pp. 919—927. Patient 3 years and 7 months old. Congenital equino-varus. Feb. 1883, excision of cuboid. Jan. 1884, section of tendo Achillis to correct equinus. Treatment continued twelve months. Five years later walks well. Metal splint shaped to foot and leg; later, paraffine boots. As soon as wound healed parts were stretched, under chloroform, and kept in position for several months. Paraffine boots renewed every month. Dr. Whitson thinks treatment after operation should be continued 12 to 18 months.

423. Same operator and reference. Patient 2 years and 3 months old. Congenital equino-varus. Aug., 1883, excision of cuboid. Treatment continued twelve months. Five years later walks well. Metal splint shaped to foot and leg; later, paraffine boots.

424, 425. Dr. H. A. Wilson. Not published. Patient 4 years of age. Equino-varus. Excision of astragalus. Entire correction. Three years later, foot straight. Braces for three years. Ankle-joint motion.

426, 427. Same operator. Patient 4 years of age. Equino-varus. Excision of astragalus. Entire correction. Eighteen months later foot straight. Ankle motion.

428, 429. Same operator. Patient 13 years of age. Extreme equino-varus. Spina bifida. Excision of astragalus. Entire correction. Eight months later foot straight. Braces. Excessive ankle motion.

430. Same operator. Patient 24 years of age. Equino-varus. Excision of astragalus. Entire correction. Fourteen months later foot straight. Ankle motion.

431. Same operator. Patient 21 years of age. Equino-varus. Excision of astragalus. Entire correction. One year later foot straight. Ankle motion.

432, 433. Dr. R. Winslow. Maryland Med. Journ., Balt., 1887–88. Patient, colored, 14 years of age. Double equino-varus, paralytic. Sept 27, 1886, cuneiform osteotomy of calcis, cuboid, scaphoid, and astragalus, right. Jan. 30, 1887, cuneiform osteotomy of os calcis, astragalus, cuboid, and scaphoid, left. Feet normal in shape. Nov. 14th, shoe worn on right. Ankylosis (bony) did not occur, but limb was more rigid than before, right. Fracture-box for three days, then plaster.

434. Dr. Wyeth, reported by Dr. V. P. Gibney. Trans. Med. Soc., N. Y., Syracuse, 1886, p. 362. Patient 8 years of age. Equino-varus, right, marked. Astragalus dislocated and longer than normal. Division of tibialis anticus and posticus, tendo Achillis, and plantar fascia; no result. Then excised astragalus and wedge at calcaneo-cuboid articulation, Nov., 1885. Dressings removed in thirty days, and result perfect. Plaster-of-Paris.

435. Dr. Zeissel. Patient 27 years of age. Equino-varus, double, congenital; great force in effectual. Excision of astragalus and calcaneum. Three months later foot inverted; walks with special boot.

Appendix.

Operators.	Operations.	Operators.	Operations.
Andrews	1	Moore	5
Augustoni, Panzeri	22	Morton, T. S. K.	1
Beauregarde	5	Morton, T. G.	1
Bennett	1	Mynter	13
Berger	2	Nélaton	6
Boeckel	7	Ollier	1
Bollici	1	Ore	3
Boursici	2	Paci	1
Boursier	1	Packard	1
Bradford	9	Park	11
Brinkmann	7	Paroma	3
Bryant	1	Patterson	1
Burrell	4	Phelps	18
Butz	1	Picque	1
Championnière	11	Piechaud	3
Charon	5	Pilcher	3
Cotterill	1	Poinsot	1
Croft	2	Poore	5
Curtis	1	Postempski	1
Davis	4	Prince	1
Davies-Colley	1	Pughe	2
Davy	25	Quienu	2
Deschamps	48	Raffa	5
Dumont	2	Rawdon	2
Duret	2	Reclus	1
Fairbank	2	Reid	4
Ferrier	1	Renton	4
Fontaines	1	Ricketts	1
Fowler	6	Richet	1
Gibney	5	Sands	4
Gillette	3	Schede	1
Goldschmidt	1	Schwartz	1
Goodman	1	Sherman	3
Grattan	23	Smith	1
Hartley	2	Solly	1
Holmemann	2	Springfeldt	1
Holmer	16	Steeg	2
Hueter	1	Studsgaard	11
Iversen	2	Terrillon	2
Jalaquier	3	Tiffany	2
Jones	1	Trendelenburg	1
Kirmisson	1	Verbelzi	1
LaFerte	1	Verneuil	1
LeBec	4	Vogt	3
LeDente	2	Volkmann	1
Lenger	2	Weinlechner	1
Lucke	1	Weiss	1
Lund	4	West	1
MacGillivray	1	Whitson	2
Margary	1	Wilson	8
Marzocchi	3	Winslow	2
Mason	1	Wyeth	1
Mensell	1	Zeissel	1
Monnier	4		

Operators, 108. Operations . 435

A CASE OF ADULT CLUB-FOOT.

By CHARLES C. FOSTER, M.D.,
CAMBRIDGE, MASS.

Double Talipes Equino-varus, Congenital.

The patient was a woman twenty-eight years old, a native of Nova Scotia. She gave her occupation as seamstress; had tried working in a cotton mill, but could not be on her feet constantly, and had to give it up. Often her feet gave out entirely for weeks at a time.

She entered the Cambridge Hospital on February 10, 1890.

The condition of the feet is shown by the casts. The right foot was very hard and unyielding; the left was less rigid, but more painful, and where it touched the ground a large and sensitive bursa had formed (shown in cast).

The feet turned inward and got in each other's way, as usual in severe cases.

The first question, of course, was as to treatment.

Four methods were practicable. First, open incision in the sole; second, removal of bone from the convex surface; third, subcutaneous division of resisting parts, followed by forcible rectification of position, and by putting up in plaster; fourth, subcutaneous cutting, followed by the use of steel shoes.

The use of shoes without tenotomy I dismissed as utterly inefficient in such a case.

The first two methods are very tempting. They are decisive; they are up to date, being made practicable solely by modern antiseptic surgery. The patient is well under control, and can do little to help or hinder the progress of the case. You are practically sure of a pretty fair result, and can achieve it within a reasonable time. But I think the *final* results can never be quite so good as the *best*

of those attained by more conservative methods, and that the gain in time is really less *to the patient* than is often supposed. The patient can be discharged from the hospital sooner without danger of recurrence of the deformity, but it is a good while before he gets the real *use* of the foot.

Removal of bone, of course, makes an abnormal tarsus, with a possibility of shortening, weakening, and interference with motion.

Incision in the sole must result in considerable cicatricial tissue, always liable to make trouble through its sensitiveness and tendency to contract.

In many cases, especially in hospital practice, I should unhesitatingly use one of these two methods, as being the only ones by which any useful result could be attained; but in this case I thought that I could do better otherwise.

By employing the old conservative method the surgeon preserves the foot in a more nearly normal condition than if he had done a decisive operation. He removes nothing; he makes very little cicatricial tissue; and when the hypertrophied bones have shrunk and the shortened tendons, fasciæ, and skin have elongated, the natural relations of the parts to each other have been regained; and the foot is far more likely to be flexible and graceful in action, and to bear the weight of the body easily and painlessly, than if these relations had been interfered with. A tarsus lacking some of its bones, and having the remaining ones more or less consolidated, or one having a mass of cicatricial tissue under it, seems to me sure to be less strong, less flexible, and less comfortable than one which has preserved all its bones in their normal size, shape, and position, with all their joint surfaces.

Unfortunately this is not always possible. The old method is slow and takes a great deal of the surgeon's time, two points that often make it inapplicable, especially in hospital work. But the greatest drawback is that the surgeon is wholly dependent upon the coöperation of his patient. Often in a hard case he must use for day after day just as much pressure as he can get the patient to bear; and the temptation must be tremendous, especially at night, to loosen one or two straps, and have a really restful sleep. In the very worst—most rigid—cases I should never attempt this method.

In this case, however, the patient had plenty of pluck, and considerable vanity to help it. She said she wanted the best looking feet she could get, and would do and bear all she possibly could to help me in securing them.

On February 11th, under ether, I divided subcutaneously the abductor pollicis, plantar fascia, and all resisting bands in the soles of the feet that I could reach; also the tibialis anticus and flexor longus pollicis. Contrary to my habit in ordinary cases, I left the tendo Achillis and tibialis posticus intact. I meant to follow the old English method of attacking the varus first and the equinus afterward, and wanted the heel held as firmly as possible as a fulcrum.

With my hands and knee I broke down as many adhesions as possible.

Modified Scarpa shoes were at once applied, but after a few days were exchanged for a more powerful screw apparatus.

Every day the shoes were removed and the feet washed, bathed with alcohol, and thoroughly exercised and stretched by hand. I consider this daily manipulation very important; and as the resisting bands, weakened by previous stretching, gave way one after another with a sharp crack, I felt well repaid for my trouble, while the moral effect upon the patient was excellent.

The prevention of pressure-sores is very important. The best pads for this purpose are made from the felt used for covering piano-hammers. This is firmer and more elastic than saddlers' felt, and distributes pressure better. A hole cut in it over any tender spot or bursa relieves it entirely. In this case great pressure was used for weeks without causing the least soreness. It is important to use several different patterns of shoes, changing them from day to day, so as to vary the place and direction of pressure as much as possible.

Hospital record of March 1st says: "Patient has had considerable pain ever since operation; restless at night.

March 10th. Less pain. Protuberance of bone on outside of left foot nearly gone, and much reduced on right foot. Bursa on left foot three-fourths gone. Soles of feet lie flat in shoes. Skin under insteps very tense, causing more resistance than anything else.

This is a common difficulty, and seems a serious one; but if the skin be kept soaked day and night with olive oil it will yield in time to steady traction.

April 3. Protuberance of bone on left foot entirely gone; nearly so on right. Bursa on left foot entirely gone, except slight superfluity of skin. Left foot straight; right nearly so. Skin under insteps much softened and relaxed.

April 14. Second operation. Tendo Achillis, tibialis posticus, and all accessible resisting structures in the soles of the feet divided subcutaneously. All possible resistance broken down by manual force. Screw shoes applied.

April 16. Feet come almost into normal position with very little force.

May 2. Patient walked a few steps in her spring shoes for the first time.

June 1. Shape of feet improved and flexibility increased. General soreness much diminished.

June 11. Feet in very good shape and condition. She can voluntarily flex the right foot to about one inch above the horizontal; left foot more. She can walk pretty well, though her feet are not yet very strong. Discharged.

For some months after her discharge I kept her under observation at her home. She took good care of herself, having her feet regularly exercised for her, and constantly wearing her spring shoes at night, though gradually adopting common shoes in the day time.

On July 1st I had a cast taken of the cured right foot, very much the worse and more troublesome one. This shows the foot still in the puffy condition which follows treatment. This steadily subsided, her boots growing too large for her, and at the same time the flexibility of the feet and her control over them improved. In the autumn she was able to go to work as a mill-hand, and has earned her living at this trade ever since. I hear from her occasionally, and she tells me that she has excellent, useful feet, which are well worth all she went through to get them.

I do not believe that any other treatment would have given her any better feet than she now has, and I doubt if she could have returned to her work any sooner after a decisive operation, though very likely she might have left the hospital sooner. I doubt also if feet so flexible, so graceful, and so well under control would have resulted. There is a great difference between walking stiffly and freely, the latter demanding pretty good flexion and extension of the ankle; the patient appreciates this as well as the surgeon.

This case was a hard one, but I think the result justifies my treatment. I also think that such a case just about marks the limit of usefulness of the old conservative method; and it is chiefly for the purpose of starting a discussion of this point that I have reported it.

FORCIBLE CORRECTION OF CLUB-FOOT BY A DOUBLE-LEVER STRETCHING APPARATUS.

By T. HALSTED MYERS, M.D.,
NEW YORK.

The treatment of club-foot would seem a trite subject were not the results obtained often so poor and the relapses so frequent. This should not be so, for during the last ten years the treatment of these deformities, both mechanical and surgical, has been reduced to an anatomical basis, and any case, however severe, can be cured.

Many surgeons, I am sure, have been led by the complicated mechanism of stretching apparatus and the difficulty of procuring them, as well as by the fact that special knowledge is required in order to apply them to the best advantage, to resort to surgical treatment where that was neither necessary nor desirable.

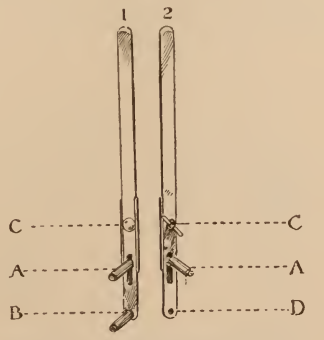
Phelps' operation of "Open Incision" is of great value in the surgical treatment of these deformities. It is, however, an operation only for the more severe and older cases; but when performed according to his rule, on proper cases, most excellent results are obtained. Excellent results are also recorded in the severest cases after excision more or less extensive of the bones of the tarsus. In the purely orthopedic treatment of these cases the "antero-posterior" and "external lateral" traction shoes of Dr. Shaffer have given us very effective instruments, designed on a correct appreciation of the anatomy involved, and I can subscribe to the statement which he makes (*N. Y. Med. Journ.*, December 31, 1887), that if the rules he has laid down are consistently followed, even the most skeptical will be convinced that "open incision" and "osteotomy" are operations very rarely called for in the treatment of club-foot.

Everyone will agree, I think, that operations *per se* are to be avoided; and if equally good or better results can be obtained without them, the duration of the treatment will in *most* cases be a

secondary consideration. If in two feet the deformities are equally bad, and if the positions resulting after treatment are also equally good, it will be agreed that that one will be more apt to relapse which has most scar-tissue, since we all know the tendency of this tissue to contract.

For these reasons it seems to me that any instrument for the correction of these deformities which is constructed on correct princi-

FIG. 1.



Double lever stretching apparatus.

A, stretching-bars; B, hinge-bar; C, clamp screws by means of which the position of the slides which carry the pressure-bars can be regulated; D, hole through which B slips.

The figure to the left represents the apparatus as a Thomas wrench.

The apparatus is made in two sizes: the smaller for children under four years of age; the larger is powerful enough for an adult foot.

	Small size.	Large size.
Length of handles	13 inches	18 inches.
Breadth of handles	$\frac{3}{4}$ "	1 "
Thickness of handles	$\frac{1}{4}$ "	$\frac{3}{8}$ "
Length of hinge- and pressure-bars	$2\frac{3}{4}$ "	4 "
Diameter of hinge- and pressure-bars	$\frac{5}{16}$ "	$\frac{4}{8}$ "
Greatest distance between hinge- and pressure-bars	$2\frac{1}{2}$ "	$4\frac{1}{2}$ "
Smallest distance between hinge- and pressure-bars	$\frac{7}{8}$ "	$1\frac{1}{2}$ "
This distance is adjusted by means of clamp screw C.		
Length of slide carrying pressure-bar	$3\frac{1}{2}$ "	$4\frac{3}{4}$ "

The apparatus is made for me by Robert Linder, 151 West 29th St., N. Y. City. The large size for $15, the small for $12.

ples, and whose application is simple and easily understood, has a distinct place in our armamentarium. The instrument to which I call your attention is *a stretching apparatus, and in no sense a crusher*, as most of this class are. It is of very simple construction. It is

very powerful, yet under our perfect control, so that we can apply whatever force we desire, and yet relieve the strain instantly at any time. It was constructed to meet certain conditions which I had not been able to satisfactorily overcome with the Thomas wrench, especially the adduction at the medio-tarsal joint.

An inspection of the photographs will show the method of applying the stretcher.

The deformity in talipes—I will take equino-varus as an example—has been described by Dr. Shaffer as made up of rotations on various axes. Thus, briefly stated, the equinus is rotation of the whole

Fig. 2.

Applied to correct rotation on the antero-posterior axis.

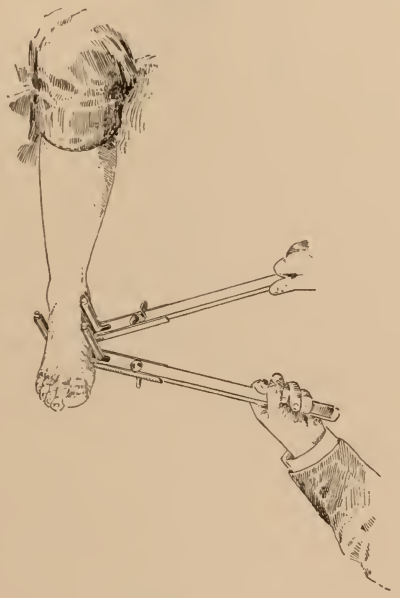
foot on a *transverse* axis passing through the centre of motion at the ankle-joint. The varus is made up of a rotation of the foot on an *antero-posterior* axis and on a *vertical axis;* the former is most apparent when the foot is inspected from behind; the vertical axes of the heel and the leg are then seen to make a distinct angle with each other. There is also generally a little of this rotation in the medio-tarsal joint. Rotation on the *vertical axis*, adducting the toes occurs in the medio-tarsal and tarso-metatarsal joints, and in the neck of the astragalus and os calcis in severe cases.

It is the rule now to correct the varus first, and afterward the equinus. Phelps reverses this order, but his reasons are not clear, as by first tenotomizing the tendo Achillis he removes the counter-

resistance so useful to us in correcting the deformity in the foot itself. Thomas (*Contributions to Medicine and Surgery*, part vii. p. 24), in young infants, also commences treatment by tenotomy of the tendo Achillis, but in cases where the deformity has been neglected, he corrects the plantar defect first.

To overcome the rotation on the antero-posterior axis with my double-lever stretching apparatus, the hinge-bar, about which both handles play, is placed just under the external malleolus; the stretching-bars are placed on the inner aspect of the ankle, one

Fig. 3.



Applied to correct rotation on vertical axis.

against the os calcis, the other above this, either just below or above the internal malleolus, where it is held stationary while the os calcis bar is carried downward and outward around the centre of motion in the hinge-bar. In this way all the soft parts on the inner side of the ankle must be stretched. If there is also a further rotation on this axis at the medio-tarsal joint it can be corrected by removing one handle and using the instrument as a Thomas wrench, the anterior row of the tarsal bones being firmly grasped between the two bars, and the handle then carried in the required direction.

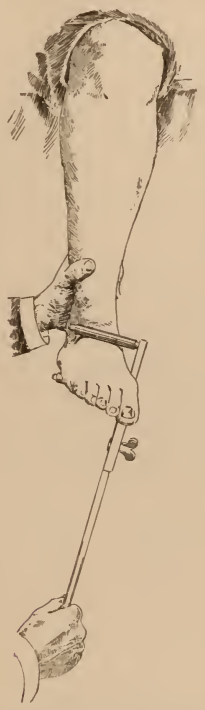
The rotation on the *vertical axis* is attacked by placing the hinge-bar on the outside of the foot just behind, or (less frequently) just in front of the cuboid, according to the location of the rotation. The stretching-bars are clamped on the inner side of the foot, one in front of the os calcis, the other behind the first metatarsal bone. The handles are then separated and both bars move about the centre in the hinge-bar, and all the soft parts on the inner side of the foot *must* yield. If the inner border of the foot shows a tendency to turn up when this pressure is applied, this can readily be prevented by pushing the knee inward, thus, of course, forcing the inner border of the foot downward.

The rotation on the *transverse* axis which occurs at the medio-tarsal joint and produces cavus is best corrected by using one handle only, as with a Thomas wrench. The counter-resistance has to be made by holding the leg firmly with the left hand. One bar is placed behind the scaphoid and the other behind the ball of the foot, and the handle carried toward the leg. To overcome the rotation on the *transverse* axis at the ankle, the hinge-bar is placed on the tibia anteriorly just above the joint; one of the stretching-bars is placed posteriorly against the lower part of the calf and held there firmly, while the other, placed just above the insertion of the tendo Achillis, is forced downward and forward about the centre of motion in the hinge-bar. I am inclined to think, however, that in the correction of equinus, my instrument is inferior to the "antero-posterior" traction shoe of Dr. Shaffer, though both act on the same principles. That Dr. Thomas considered his wrench quite inadequate to overcome this deformity I think is evidenced by his advocating tenotomy of the tendo Achillis, either before or after twisting. In this connection I would call attention to the fact that the resistance to dorsal flexion at the ankle is almost entirely confined to that offered by the tendo Achillis in cases which have not been previously tenotomized, though there are occasionally exceptions to this rule, especially in long-standing cases where abnormal bone-growth may have occurred in the articulating surfaces, or the posterior part of the capsular ligament become thickened and shortened. For this reason the same objections to tenotomy of the tendo Achillis do not exist as to section of the plantar tissues, where the total resistance is made up of so many parts that it is practically impossible

to correct them all by tenotomy or syndesmotomy. Where the parts have been operated upon previously this stretcher is very useful, as it attacks all the undefined resistances so often troublesome. It can readily and safely be used also after the major resistances have been overcome by the knife or chisel.

The deformity of valgus can be attacked by reversing the directions given above. The apparatus can also be used as an osteoclast

Fig. 4.



Applied to correct rotation on the transverse axis; as a Thomas wrench.

for bow-legs, the hinge-bar being placed at the apex of the convexity, and the other bars on the other side of the bone to be broken, acting in a similar manner to Thomas's osteoclast. I have used it successfully in four cases of bowed legs, and four cases of knock-knees in children between four and six years of age, but in two cases of knock-knee between five and six years I failed; subsequent osteotomy showed the bones were eburnized.

Dr. Thomas advises (*op. cit.*, p. 18) in the use of his wrench, and the rule will apply here also, that "the force employed to correct deformity should be used at periods too short to allow of the part recovering from a preceding manipulation, yet not so limited as to cause the repeated manipulations to bring about such a degree of tenderness that it may necessitate the interruption of corrective treatment."

Only the soft parts, the muscles and ligaments and the cartilages, are, as a rule, affected by this stretcher. Bone changes other than displacement will require surgical treatment. Phelps claims that only ten per cent. of the cases, as we meet them, require operation on the bones. As Dr. Shaffer has repeatedly pointed out, we cannot at once decide that a given case is "inveterate and will not yield to traction. The best plan is to try stretching. If this alone is not successful, do tenotomy and syndesmotomy and stretch; or, finally, a bone section if necessary."

In the application of my instrument it is better to give an anæsthetic, as the pain is quite severe. The stretching may not be entirely successful the first time; a tendency to relapse may be noted, and subsequent stretchings, perhaps three or four, may be required. Thomas found from four weeks to four months sufficient time to secure a symmetrical foot, even in extreme cases. With my more powerful instrument this result should be obtained at least as speedily.

I have had no bad results or accidents from its use, other than an epiphysial fracture of the tibia in one of my earlier cases, which did not interfere with the result except by causing a few weeks' delay.

Rubber tubing is slipped over the bars to make the local pressure less harsh. The tubing is large enough to revolve on the bars as they move over the skin, and so abrasions are avoided. The skin will bear very severe momentary pressure without damage.

A hyper-corrected position should be secured and a retention apparatus at once applied. After the first stretching the pain may last a day or two, and the swelling a day or two longer. This is unusual, however, and the secondary stretchings always cause still less disturbance. Generally there is pain for a few hours, but the next day the child will be willing to walk about some. Even after the hyper-corrected position is gained a retention shoe should be

worn for six months to maintain the good result, and every means must be employed during this time to develop the normal muscular equilibrium. The latter point cannot be emphasized too much. From the experience I have had with this instrument I feel confidence in recommending it to this Association as simple, safe, and efficient even in very severe cases.

DISCUSSION.

Dr. Phelps said he would say in regard to open operations and the method of operating, that he had reported a hundred and sixty odd cases, and afterward forty to fifty more, making something like two hundred cases of club-foot operated upon by incision. Since that time he had operated on nearly another hundred or, at least more than seventy-five more cases. These were cases which had been treated by all the well-known orthopedic methods, and were classified as relapsing club-foot. He found that it was necessary in these three hundred cases to perform a bone operation in about ten per cent. of all the cases. The mortality he thought was a little more than was laid down in this paper. He had made a research a few years ago, and he had found that the mortality then was between four and seven per cent. He was very glad to know that it was less than three per cent. Out of three hundred operations he had not had a single death.

Dr. Bradford wished to say one word. He desired to make his acknowledgment of his conversion to Dr. Phelps' method. He could do so more freely, for the reason that he had been very much opposed to that method until recently, thinking that osteotomy would do all that was necessary. He wished to say frankly that he had been in error.

A CONTRIBUTION TO THE STUDY OF CLUB-HAND.

By REGINALD H. SAYRE, M.D.,
NEW YORK.

Congenital club-hand is a deformity of very much less frequent occurrence than club-foot, and its cause is involved in equal obscurity.

There are club-hands of the acquired variety, caused by vicious cicatrices, as a result of burns, by paralysis of certain muscles or contraction of others from central nervous irritation, and in other cases resulting from injuries to the bones of the hand or forearm, but these do not properly come under the head of club-hand such as I wish to mention. As examples of these acquired forms, I might mention the following cases:

In the *Medical News*, May 12, 1888, J. K. Young reports a case of club-hand, due to irritation of the brain, which disappeared on the removal of the disturbing influence. The infant was delivered by forceps after a protracted labor, and the left side of the head much crushed. A large hæmatoma formed here, and subsequently the right hand was markedly adducted, and the fingers and thumb flexed, and the hand was flexed at the wrist, forming almost a right angle with the forearm in the radio-palmar position. The muscles on the radial side of the forearm were firm. The hæmatoma was incised, profuse bleeding followed, and subsequently the deformity gradually subsided, disappearing twenty-four hours before death, which occurred some days later. At the autopsy a fracture of the left parietal bone was found over the position occupied by the ascending frontal and parietal convolutions, which had been subjected to great pressure from the effused blood.

Bilhaut, in the *Annales d'Orthopédie,* May, 1893, relates a case of club-hand which was supposed to be congenital, but which was really the result of a fracture of the ulnar at birth, or soon after, with

subsequent loss of bone from suppuration, giving rise to inequality in the length of the bones of the forearm, causing sharp deflection of the hand toward the ulnar side. For the relief of this condition the author proposes to remove a portion of the radius, and so make it of equal length with the ulnar.

The congenital cases of which I wish to speak are of a different kind, and may be divided into three varieties: 1. Those where the skeleton is complete and well formed. 2. Where the skeleton is complete but ill formed. 3. Where the skeleton is incomplete and distorted. It is said by various writers that the majority of cases come under the third head, but in the author's personal experience this has not been so, only two of the five cases that have fallen under his observation showing absence of portions of the skeleton; but, of course, this number is far too small to be used in drawing conclusions of any sort.

In four of these patients there was club-foot of some variety, and in one case an hypertrophy of one great toe. The large majority of reported cases are associated with abnormalities of development of some part of the body.

The direction of the deformity may be either in flexion or extension, abduction or adduction, or a combination of two, the most frequent seeming to be the radio-palmar variety.

In those cases where the bones of the hand and forearm are present the prospects of a good result are more favorable than where there is absence of one or more bones. In these milder cases when seen early it is sometimes possible to restore the hand to proper shape and function by constant manipulation and retention of the parts in an improved position by some fixed dressing, as, for instance, plaster-of-Paris bandage, changing the dressing from time to time as the deformity is reduced. Section of the tendons, or ligaments, or fascia, may become necessary, especially if the case is not seen in the early stages.

Many of these structures are so situated as to make open section much more preferable than the subcutaneous method, and if the flexor tendons have to be divided it would seem better to operate on the forearm instead of the hand, and to split the tendons longitudinally, and, after having gained such additional length as was needed by sliding the ends past each other, to suture them together once more.

I have seen two cases where the deformity was due to shortened flexors of the fingers, one of which had been previously operated on in Baltimore by section of the flexor carpi radialis and flexor carpi ulnaris, with great improvement as to function, according to the statement of the parents; but the hand was much distorted and the fingers could be extended only when the wrist was flexed sharply on the forearm; in this case the parents were obliged to leave town before any operation was practicable; and in a second of similar though less aggravated character the presence of inflammation of the cervical vertebræ made it expedient to give an anæsthetic, and the operation was therefore postponed.

In a double congenital club-hand at present under treatment the position has been very markedly improved by manipulation and plaster-of-Paris bandages.

Another case of the more aggravated kind has also come under my observation, and these are sufficiently rare to warrant me in describing it at length.

R. B., aged nine years, was seen by me in December, 1892, having a congenital club-hand and club-foot of the right side, and also a lateral curvature of the spine, the concavity being on the right side. The lateral curvature was apparently due to the imperfect development of the whole right half of the body, the right upper and lower extremities both being markedly smaller than their fellows. This might possibly be accounted for by disuse, as, on account of the very severe form of club-hand and club-foot, the boy had depended almost altogether on the left half of his body for assistance. The club-foot was an extreme varo-equinus, and was treated by deep subcutaneous incision in the sole of the foot, and tenotomy of the tendo Achillis, the foot then being immediately replaced in the normal position by means of Bradford's club-foot twister, it being necessary to employ a very considerable amount of force to effect reduction. The foot was then kept in position by plaster-of-Paris boots, renewed about every three weeks until at the present time his foot is practically in a normal shape.

The club-hand was almost the counterpart of one described by Kirmisson and Longuet in the *Revue d'Orthopédie*, January, 1893, and which they had an opportunity to dissect. The radius and thumb were absent as well as the first metacarpal bone and a certain num-

ber of the carpal bones. Exactly which of the latter were absent I am unable to state. The ulnar was curved in its middle at an angle of about 30° toward the side where the radius should have been. The hand was almost at right angles with the forearm, bent toward the radial side and flexed on the forearm. The carpus did not articulate with the ulna, but was attached to it by means of firm ligamentous bands.

I first did an osteotomy of the ulna to correct the curve, and after the bone had firmly united in a straight line, endeavored to stretch the contracted tissues on the side of the arm where the radius should have existed, by means of adhesive plaster attached above and below the wrist, and passing around the ends of a wooden splint, which was fastened to the forearm.

After several weeks of traction, the hand could not be drawn down far enough to permit the ulna to slide above the carpus, although a considerable elongation of the contracted tissues had been effected. It had been my intention to endeavor to form an artificial joint between the lower end of the ulna and the carpus, but on cutting down upon the bones I found that after freeing the end of the ulna from all ligamentous attachments, it was impossible to draw the carpus clear of it, and I therefore removed what I took to be the os magnum and unciform. The scaphoid and semi-lunar apparently did not exist, as in the case which Kirmisson and Longuet describe. The tip of the styloid process of the ulna was then cut off, and the end of the bone inserted into the gap in the carpus formed by the removal of the carpal bones. I had originally intended to wire the bones fast in this position, but on second thought, determined to leave the ulna free, thinking that a more serviceable hand would result from this method, and that the bones could be wired together later on, if necessary. This operation, of course, shortened the upper extremity still more than Nature had already done, but it seemed to me wiser than the very extensive division of tendons and muscles which would have been required in order to permit the carpus to be pulled down to the extremity of the ulna. The hand was dressed in a straight position, and after about three weeks, movements of the wrist were made with the object of creating, if possible, a serviceable joint which should be under the control of the patient.

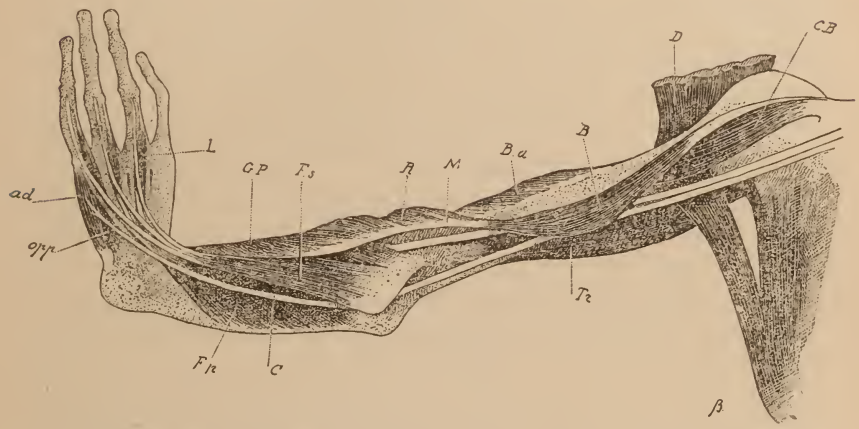
Fig 1.

Congenital club-hand before and after operation.

The position of his hand before and after the operation is shown in the accompanying photographs, and the boy's control of his motions and his ability to grasp objects is greater now than it was before the operation, while his appearance is vastly improved. He is still wearing an apparatus with a joint at the wrist, allowing flexion and extension, while retaining the bones in a better position than they assume when left to themselves.

In the case described by MM. Kirmisson and Longuet,[1] the shape, general appearance, and situation of the defective bones correspond so closely with the case I have just narrated that I think it worth while to quote quite largely from their description of the autopsy.

Fig. 2.



B, biceps whose tendons pass in front of the elbow to join the muscles of the forearm; *C B*, coraco-brachialis; *B a*, brachialis anticus; *Tr*, triceps; *R*, flexor carpi radialis; *G P*, palmaris longus; *Fs*, *Fp*, superficial and deep flexors; *M*, median nerve; *C*, ulnar nerve. (After Kirmisson and Longuet.)

Muscles.—*Arm.* At the upper end there was a complete absence of the long portion of the biceps; the short portion seemed to be normal. At the lower end, the tendon which is inserted into the bicipital tuberosity was absent, and the biceps was gradually merged into a rectangular muscular fasciculus in front of the elbow-joint. The brachialis anticus was remarkably small. The other muscles of the arm were normal but very slightly developed. On the anterior sur-

[1] "Nouveau Cas de Main Bote Congenitale," Revue d'Orthopédie, January 1, 1893.

face of the forearm the muscular anomalies were so marked as to render it difficult to recognize what muscles were present. There was no pronator radii teres. On the inner border there was a muscular fasciculus continuous with the rectangular muscular mass, spoken of above, which below spread itself out at the edge of the carpus, and seemed to correspond to the palmaris longus. The flexor carpi ulnaris was absent; the superficial and deep flexors were in a confused group at their upper extremities, and it was impossible to separate the one from the other at their lower insertions in each of the three last fingers, counting from the ulnar side of the hand. There was no flexor tendon going to the atrophied finger, which corresponded to the index; there was no flexor proprius pollicis nor pronator quadratus. On the posterior surface of the forearm the supinator longus and brevis were absent. An undetermined little muscle, which was confused with the other muscles of the posterior surface of the forearm, was inserted toward the external part of the carpus, and represented the radial group. A little muscle fibre ran from the epitrochlear fossa to the internal edge of the carpus. There was no anconeus, and no extensor minimi digiti. A single muscle fibre went to the ulnar side of the second finger, representing the extensor communis digitorum.

Hand. On the outer border of the hand there were no muscles to form the thenar eminence; three lumbricales were present; there were no interossei.

Nerves.—The median nerve was normal. The ulnar passed the elbow in the usual position, and was lost on the inner side of the hand. The radial sprang from a common trunk with the musculo-spiral, and was lost on the forearm.

Skeleton.—The scapula and clavicle were well formed; the humerus had no bicipital groove; the musculo-spiral groove was normal; the elbow-joint was very much relaxed; only the trochlear surface of the humerus was covered with cartilage; the sigmoid cavity of the ulna was well shaped, but allowed only slight movement of flexion and extension of the elbow-joint. There was a very sharp anterior curve in the ulna which made the styloid process very prominent. The radius was absent. The carpus consisted of five bones: two of the first row—the cuneiform and pisiform, and three of the second row—the trapezoid, os magnum, and unciform. The

scaphoid, semilunar, and trapezius were absent. The two internal metacarpals were also absent; the other respective phalanges were normal, but the index and the second metacarpal which it supported were very short; there was no thumb.

The most extensive article on the subject is that of Bouvier, in the *Dictionnaire Encyclopédique*, in which are arranged in tables all the cases reported up to 1871. Of the dissections of several cases he gives minute details, and also illustrations of the anomalies, which correspond very closely to the defects in development found in the present case. In regard to treatment but little is said except that stretching and tenotomy are useful in certain cases, and may be supplemented by apparatus.

Le Dentu, in the *Dictionnaire de Jaccoud*, also enters largely into the description of this affection, but says little as to treatment.

Bradford and Lovett, after mentioning the different positions in which the hand may be found, say, in regard to treatment, that in the worst cases where there is much bony deficiency, the choice lies between amputation and doing nothing. In the milder cases of resistant muscles, stretching by manipulation and apparatus may be efficacious. In general, the treatment must be varied according to the severity of the case.

St. Germain divided club-hand into three groups, similar to those I have mentioned above. Three such cases are in the Dupuytren Museum, and are mentioned by Malgaigne in his *Lessons on Orthopedic Surgery*. He suggests manipulation and the employment of apparatus to remedy the deformity.

Redard recommends manipulation and massage in young children where there is but slight fibrous or tendinous resistance; tenotomy is to be done only on the flexor carpi radialis, ulnaris, and palmaris. He does not think very highly of the various orthopedic appliances, and believes that resection and arthrodesis are very rarely indicated.

Hoffa goes quite extensively into the various varieties of faulty development of the upper extremity which may give rise to club-hand. That due to the absence of the ulna is very rare, Burckhart and Birnbacher having been able to find only seven reported cases. In regard to treatment, Hoffa mentions massage and retention by means of apparatus, but gives almost no details, while Holmes and Owen are equally brief in their remarks on this point.

The operation which I practised on the case just mentioned is, as far as I have been able to review the literature of the subject, the first of its kind yet described.

The ulna does not stay in its place as well as I should wish, and if I were to operate on a second similar case I should endeavor to remove the carpal bones without severing the posterior ligaments, and in this manner leave a pocket into which the end of the ulna might be placed, and I may still perform some such operation on this boy if his hand does not seem sufficiently useful.

In a case described by Bouvier which is in the Dupuytren Museum, such of the carpus as is present articulates with the ulna on the side where the radius should have been, the radius being absent. In such a case the proper operation would seem to be to divide the ulna just above the articulation with the carpus, and to turn it at right angles, letting the outer surface reunite with the cut end of the ulna, and thus bring the hand into a straight line with the arm, at the same time preserving the wrist-joint.

The anatomical peculiarities of these cases are such that each must be judged by itself, and this brief sketch of the subject is simply offered as contributing to the scant literature of a subject on which much may still be said.

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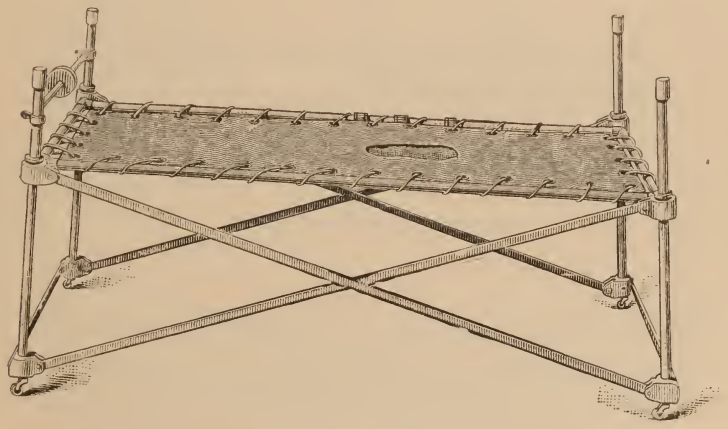
A SURGICAL COT.

By JOHN C. SCHAPPS, M.D.,
BROOKLYN, N. Y.

This cot (Fig. 1) is a development of the familiar canvas-covered frame with provision for supporting it at any convenient height or incline, and for the application of adjustable pressure to any part of the spine, traction to the spine or to a limb, and for suspending a limb. It is designed to maintain an uninterrupted recumbency so

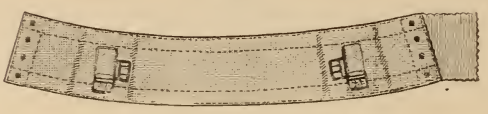
Fig. 1.



that the relations of the parts under treatment remain unchanged or subject to only such change as the surgeon may determine. A hole, long and narrow, is provided for urination and defecation, and the anus should be located at its upper end. The hole need not be large enough for the patient to sag into. The vessel is supported in any convenient manner underneath, and the hole when not in use is closed by a flap secured by stout straps. Padded straps are sewed to the

canvas so as to buckle around the shoulders and keep the patient down, and also serve to keep him located at the proper relation to the opening in the canvas. A pelvic belt (Fig. 2.), laced on and

FIG. 2.



provided with two buckles on each side, is used to strap the patient's pelvis to the cot, and also to make some counter-traction on the pelvis. For use in Pott's disease, pads are arranged to fill the hollows of the

FIG. 3.

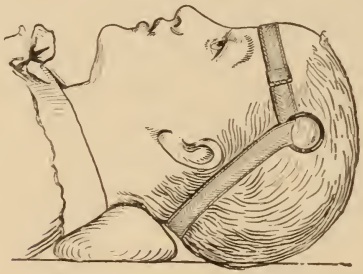
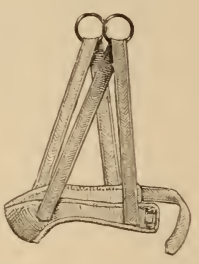
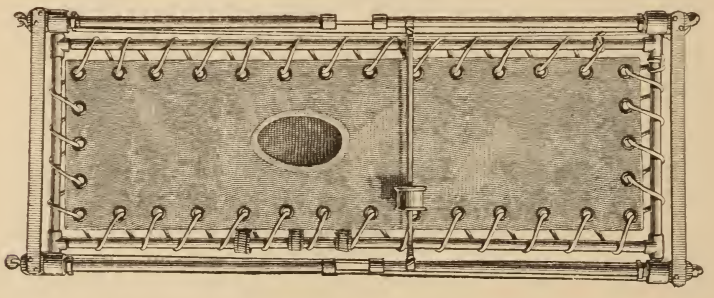


FIG 4.



cervical and lumbar regions and also to press on each side of and so protect the prominent projections (Fig. 3). The whole spine should receive support. To make adjustable pressure on the kyphosis, web

FIG. 5.



straps cross underneath the canvas and buckle around the side-bars. Traction is applied to the head by means of the head-pieces shown

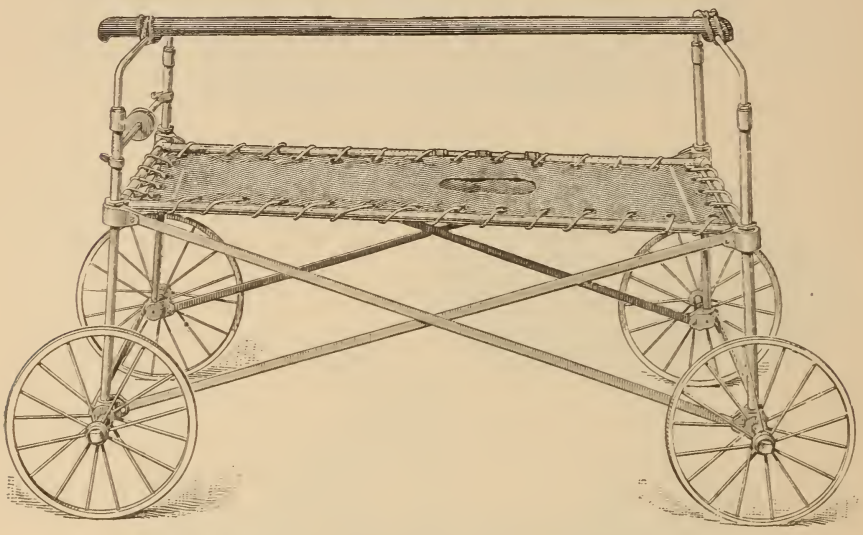
in Figs. 3 and 4. The cord sustaining the weight passes several times around a broad wooden drum which revolves and slides on a bar so that the cord cannot be jammed or thrown off. When traction is needed on the lower extremity, the bar is placed at the other end of the cot. For flexion of the thigh in spinal or hip disease, an adjustable inclined plane is added. For the support from above of

Fig. 6.

an arm or leg, a bar is provided which may, by means of wickets which slide into the uprights, be secured at any convenient height (Fig. 7). The railroad splint is used for fractures of the thigh. It should be long enough to give a firm support to the whole limb. If preferred, the canvas may be replaced by a board with a trap-door secured by hinge and button. The padding will then need to be cut accordingly. Fig. 5. shows the cot closed. By the addition of a

parasol and rubber-tired wheels it is converted into a perambulator (Fig. 6). It is made by W. F. Ford, of Fifth Avenue, New York, in

Fig. 7.



sizes up to fifty-six inches. By means of this apparatus I have been able to maintain an uninterrupted condition of rest with perfect comfort for months at a time.

OBSERVATIONS ON POTT'S DISEASE,

WITH REFERENCE TO THE PRINCIPLES OF TREATMENT AND THEIR APPLICATION.

By ROYAL WHITMAN, M.D.,
NEW YORK.

THE principles which govern the treatment of Pott's disease are somewhat as follows: It is tuberculous in character; therefore the general condition of the patient must be sustained by the constitutional and therapeutic measures that are indicated in other manifestations of tuberculous disease. It is a local affection of the bones and joints of the spine, accompanied by symptoms of pain and deformity that may be relieved or prevented by restraint of motion, protection from injury, and removal of superincumbent weight.

The treatment under which the general health is maintained, by which a proper attitude of the entire body is assured, which relieves pain and prevents deformity, is effective; when these conditions are not fulfilled, treatment is ineffective.

The successful treatment of Pott's disease depends upon:

1. A knowledge of the functions and relations of the different portions of the spine, in order that one may interpret the early symptoms of disease, because a diagnosis can and must be made before the stage of bone deformity if the best result is to be attained.

2. A knowledge of the deformities and complications of disease peculiar to the region affected, in order that one may foresee and guard against them, for the final deformities of Pott's disease differ very materially with the region of the spine involved.

3. An apprehension of the nature of deformity and of the conditions that favor or retard its progress.

4. An appreciation of the duration and extent of disease and deformity, of the quality of the patient and the nature of his environ-

ment, in order that treatment may be applied intelligently or that a necessary compromise may be made between what is best and what is possible. The treatment of the patient in distinction to the treatment of his deformity is one of the more common and difficult problems, because patients are not often seen in the early stages of disease. The popular idea of Pott's disease is that it causes a hump, that the diagnosis is made because of the hump, and that the treatment consists in the application of a brace or plaster jacket without regard to the extent or position of the hump or to the symptoms or complications of disease. Consequently patients are brought for treatment in all stages of deformity or suffering, it may be from symptoms or complications that may call for special treatment, either because they directly influence the course of the affection or indirectly increase the tendency to deformity.

In one, the constitutional depression of the tuberculous disease is out of proportion to its local manifestation; in another, great deformity has been acquired with practically no effect on the general condition. The complication of abscess may from its position endanger life in one instance, while in others it may increase the tendency to deformity, or interfere with effective support, or remain for a time and disappear without symptoms or consequences. The treatment which may be most effective in childhood, when the danger of deformity is greater than the danger to life, may not be applied to the adult, for whom the relative danger of the constitutional and local disease is reversed.

The object of treatment is the prevention of deformity; not only because the effect of treatment is estimated by the degree of ultimate deformity rather than by the survival of the patient, but because deformity itself, after complete recovery from constitutional and local disease, by its distortion and compression of vital organs, is a constant source of weakness and danger.

To apprehend the nature of deformity, its causes and final results, one must bear in mind the fact that the spine is a flexible column, which, balanced under the influence of the force of gravity, is constantly changing its shape to accommodate itself to the different attitudes and movements of the body.

If by disease the function of one portion is interfered with, another part must accommodate itself to the change.

If one section is deformed or thrown out of its true relation to the weight line, another part must change in the opposite direction.

These compensatory changes, though bearing a necessary relation to the original cause, may, in the growing child, become exaggerated and independent deformities, or permanent distortions may be acquired which originally were merely symptomatic of disease. The deformities of Pott's disease may thus be divided into two groups, the essential and the non-essential. The essential deformities are those caused by destruction of bone and loss of growth—two factors modified to a great extent by early diagnosis and efficient treatment.

FIG. 1.

FIG. 2.

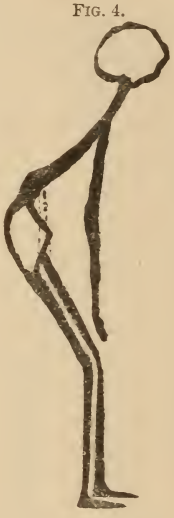
Pott's disease is a destructive process which affects the bodies of the vertebræ, the weight-supporting portion of the spinal column. As the effect of weakness and loss of support, the superior section of the spine inclines forward, bringing more weight, and thus the influence of attrition, to bear on the diseased area. The more rapid the destructive process, the more often abscess complicates the condition; this abscess may dissect its way down the spine, infecting other vertebræ in its progress. It is apparent, then, that while the disease causes deformity, the deformity may increase the disease.

The non-essential and more distinctly preventable deformities are those which depend upon the symptoms or complications of the dis-

ease; one of these is muscular spasm. In disease of the cervical region, for example, the head may be drawn into a wry-neck position, which, if allowed to persist, becomes a permanent deformity, for contracted tissues do not grow and the bones of the spine quickly accommodate themselves to the changed condition of weight and function; or abscess which involves muscles and fascia may induce a faulty attitude. This is well illustrated in disease of the lower region of the spine, in which the compensatory lordosis or over-erectness of the body is one of the favorable factors in prognosis (Figs. 1 and 2). When, however, psoas abscess causes flexion of the

FIG. 3.

FIG. 4.



thighs, the erect posture is impossible (Fig. 3); thus the habitual attitude becomes most unfavorable and, if it is allowed to persist, permanent and unnecessary deformity may result (Fig. 4).

Simple weakness is another element of deformity. When one sees a child suffering from dorsal disease walking about in the squatting attitude of weakness, supporting the body by the hands on the knees, it is very evident that treatment is ineffective, because a proper attitude is not maintained.

After the cure of the primary disease, the resulting deformity and the general weakness favor secondary curvatures of the spine, just as weakness and faulty attitudes may cause postural curvatures without the influence of local disease.

When the spine is distorted, the thorax must, in a certain degree, participate in the change; but the exaggerated pigeon-breast deformity of dorsal disease can be prevented by efficient treatment.

The natural tendency of Pott's disease is to cause a right-angled deformity at the point of weakness. The opportunity for deformity is greatest when the middle of the spine is diseased, because the column is broken in the centre. The opportunity for deformity is small when either extremity is affected, because the deformed portion is insignificant compared to that which remains intact. It is evident, then, that it is not the mere angular projection, the direct and essential effect of the local disease, which is of importance, but that the true measure of deformity is the effect of the disease or deformity on the spine as a whole. (Contrast Figs. 6 and 7.)

Each region of the spine, because of its position, functions, or relations, presents certain peculiarities which influence prognosis and treatment. Disease of the occipito-axoid section, the region of true joint motion, is not infrequently a primary affection of the synovial membrane; consequently, more acute in symptoms and rapid in progress.

Disease of this region is more dangerous because of the proximity of the vital centres and because of the possibility of sudden displacement and pressure on the cord.

It is not infrequently complicated by abscess, which, unable to find an outlet, dissects its way about the contiguous vertebræ, or forms a tumor in the throat which may interfere with breathing and swallowing.

On the other hand, because of the acute symptoms, an early diagnosis is usually made, and, under favorable circumstances, the course of the disease is short and the result favorable.

The most disastrous deformity of this region—one not infrequently seen in untreated cases—is caused by the falling forward of the head so that the chin becomes fixed upon the sternum. The indications for treatment are to prevent ultimate displacement of the head by fixing it in the line of the normal spine and at a right angle to it.

The prognosis in disease of the middle of the neck is favorable from all standpoints, because the special movements of the head are unaffected and because the opportunity for final deformity is slight. Children are often brought for treatment in whom the right-angled

deformity, concealed by the occiput, has never been discovered by the parents or physician. Disease of this region is often accompanied by painful contraction of muscles and distortion of the head, often complicated by enlarged or suppurating glands or sinuses. The indications for treatment are therefore the removal of the superincumbent weight of the head and relief of muscular spasm by active extension.

In disease of the upper and middle dorsal region the prognosis is particularly unfavorable as regards deformity. The disease is not, as a rule, discovered at an early stage, because motion in this region is slight, and the symptoms are therefore not pronounced.

FIG. 5.

FIG. 6.

The normal posterior curvature of the spine is markedly exaggerated by slight deformity, while the compensatory lordosis tends to increase rather than to limit the kyphosis. The course of the disease is long, and the tendency to increasing deformity remains after complete cure of the local disease. The direct effect of deformity in compressing and distorting the thoracic viscera, and thus causing permanent weakness, is often very apparent (Fig. 5). A most serious and not infrequent complication of disease in this region is paralysis from secondary implication of the spinal cord. The indications for treatment are to combat all deformities, primary or secondary; to prevent the forward inclination of the head and neck; to restrain

unnecessary movements of the arms; to draw the shoulders backward; to prevent the secondary deformity of the chest and the compensatory lordosis.

The prognosis in disease of the middle of the spine is favorable if the patient is seen in the early stage, because the mechanical conditions are such as to make apparatus effective in relieving symptoms and preventing deformity. If neglected, disease of this region produces the typical humpback (Fig. 6), the dwarfed stature, the square shoulders, the sunken head, and the distorted back and chest.

At a lower point the attitude symptomatic of disease tends to prevent great deformity, but in a large proportion of cases abscess and psoas contraction change this attitude to an unfavorable one. The indications for treatment are to restrain the awkward attitude of over-erectness and to guard against the effect of psoas contraction. If this contraction is on one side only, the proper attitude of the spine may be maintained by providing the patient with a high shoe on the unaffected leg and crutches. If the contraction is of both sides, the patient should not be allowed to go about, but the irritation must be relieved by complete rest, or the abscess treated directly.

In the two regions of the spine, the upper and lower, in which abscess most often makes its appearance, radical operation is most often indicated; in the first, because of its position; in the second, because of its size and deforming influence. In both these regions it is sometimes possible to reach and remove the source of suppuration. Except as an imperative necessity, the radical treatment of abscesses should not be undertaken unless the proper conditions for treatment can be assured, unless the source of pus can be reached, and unless there is a fair prospect of avoiding a suppurating sinus, which is often a source of danger and discomfort to the patient or interferes with effective support.

Abscess is a symptom of disease of which the importance is estimated by its effects. It may be prevented, and its extent and course may be modified by proper treatment of the cause of which it is a symptom. The aspiration of abscesses, with the injection of antituberculous remedies, is the treatment by preference. It is often effective and always harmless.

In the treatment of Pott's disease, rest and fixation in the horizontal position fulfil all the mechanical conditions: superincumbent

weight is removed; the function of the diseased spine ceases; jars, injury, and overfatigue are impossible.

On the other hand, this treatment is incomplete in itself, because it must be supplemented by some form of mechanical support when the erect posture is again assumed.

It necessitates confinement and lack of exercise, the constitutional stimulation very essential in the treatment of tuberculous disease. The duration of Pott's disease is estimated in months and years; thus the moral effect of helplessness and confinement for such a period must be considered. In general, this treatment is a last resort, or is a temporary measure indicated for the relief of pain or threatened complications. In certain cases it is the treatment by preference; as in infancy and early childhood, because the spine is in great part cartilaginous, the effect of disease in checking the growth and in the rapid production of deformity is very marked.

Young children submit very readily to a treatment that relieves them of discomfort and pain—that is, in fact, a simple prolongation of the helplessness of infancy.

The treatment is usually indicated for a longer or shorter time under the following conditions: In disease of the upper cervical region, because the head may be fixed, the danger of abscess lessened, dislocation and deformity prevented, pain relieved, and the progress of the disease checked before joint motion is greatly impaired. In disease of the upper dorsal region in young children, because progressive deformity is difficult to control, and a proper attitude difficult to maintain by apparatus. In disease of the middle thoracic region, in which the grunting respiration and the faulty attitude—the evidences of pain and weakness—show that treatment is ineffective. In disease of the lumbar region, in which the complication of psoas contraction makes the erect posture difficult or impossible.

This treatment is always indicated when pain is not relieved by other means; in the acute phases of disease, shown by pain, fever, and rapidly increasing deformity; in the complication of paralysis; or for the radical treatment of abscess.

To be effective, the rest treatment must always include fixation and often extension, and the apparatus must be entirely independent for its effectiveness of the bed on which it is placed. The most simple and useful appliance is, I believe, the frame first recommended

by Bradford. The frame is made of light steel bars or gas-pipe, a little longer and as wide as the child's body. This frame is covered by canvas, which is made smooth and rigid by straps or corset lacings on the under surface; between the two layers a thin hair mattress may be inserted if desirable.

For older children it is well to apply the canvas cover in three sections, the narrow middle sheet to be removed for the use of the bedpan. This is unnecessary when diapers are used, the middle portion being protected by rubber sheeting.

Two or more sets of covers (sheets) are necessary, in order that the apparatus may be perfectly clean, for an unclean child is always neglected.

The patient must be fixed to the frame; the child who can raise the head or turn the body is uncomfortable and unhappy because he cannot sit up, but when motion is impossible he quickly accustoms himself to restraint. To fix the patient, the shoulders and the head are the two points of advantage. If the shoulders are fixed, he can not turn over; and if the head is held, he will not attempt to sit up. The patient is usually attached to the frame in the following manner: A broad swathe surrounds the body and the frame, and straps attached to the frame are passed over the shoulders and through the axillæ, while a band across the chest prevents displacement.

Traction is indicated in cervical disease, and may be applied with advantage in disease of the upper dorsal region, with the aim of reducing deformity. Traction is easily accomplished by the ordinary halter attached to a slightly flexible steel upright, screwed to the brace after the manner of the jury mast. The amount of traction is regulated by raising the head of the frame; this allows the child to look about, and is often as effective as the weight and pulley. Pillows beneath the head are not often indicated; in fact, it is sometimes necessary to loosen the upper part of the canvas so that the occiput may fall back, and to place a pad beneath the dorsal region if effective traction is to be applied in disease of that region; by this means in young children it is sometimes possible to reduce what is apparently deformity of bone. In the treatment of cervical disease, particularly in those cases in which the displaced bone projects forward, it may be necessary to place a pillow beneath the head as a temporary support.

Psoas contraction, even if complicated with abscess, often disappears under the influence of rest. If, however, this position has long been maintained, it may be necessary to apply traction to the legs, as in the treatment of the deformities of hip disease.

The rest treatment is not often indicated in cases of great deformity, or in half-grown children or adults, except to meet certain indications, some of which have been mentioned; but it may be applied, and almost always with advantage, in the treatment of any region of the spine in infancy or early childhood. The patients may be taken into the open air daily, pain is relieved, the condition of the patient improves, while growth is often very rapid. Strong objection to the treatment is often made by the parents, but, once applied, its effects are so apparent that it may be continued without protest until other indications call for change.

If the essential conditions can be fulfilled by treatment which does not confine the patient to the bed or house—in other words, does not make an invalid of him—this is the treatment by preference.

The principle of support in the erect posture is this: If the body is inclined forward, the weight or pressure is supported by the bodies of the vertebræ. When the body is inclined backward or held in the upright position, more weight is supported by the articular processes. This is what is meant by relief from superincumbent weight as effected by a spinal support; in addition, it fixes the spine and protects it from the injury of motion.

If the point of disease is above the thoracic section, superincumbent weight may be actually lifted; the body support then acts primarily as a base of support for the attachment which fixes or lifts the head.

The two types of appliance used are the plaster jacket and the spinal brace. Each of these has advocates who seem to base their conclusions on the failures of the one rather than on a personal comparison of the merits of the two; the desirability of interchanging the two methods of treatment is not often considered in the discussion or writings on this subject.

The jacket is brought into disrepute because it can be so easily and is so often applied by those who have a blind faith in its efficacy as a specific for humpback; the brace, because of a lack of knowledge of the principles of its construction or application.

The jacket is in fact a simple circular plaster bandage, which, like any other plaster bandage, depends for its efficiency on the size and irregularities of the surface to which it is applied and on the distance to which it extends on either side of the point to be fixed; for example, a plaster bandage applied to the knee of an adult may be an effective support, yet is useless on the leg of an infant. So the plaster jacket may be admirably effective when applied under proper conditions, and absolutely ineffective under others.

The plaster jacket provides a general support for the trunk as a whole; solid at the sides, front, and back; less accurately adjusted than the brace at the seat of disease. The abdomen is supported and counterpressure applied to the chest without uncomfortable tension. The jacket is most effective as a support in disease of the middle of the back, less effective at a lower point, because the unyielding plaster does not allow the accurate adjustment to the pelvis that may be afforded by the brace. The brace, which is more effective in the lower region, is also more effective in the middle and upper dorsal region, because, by an appliance that I have elsewhere described (TRANSACTIONS OF THE ORTHOPEDIC ASSOCIATION, vols. iv. and v., and the Philadelphia *Medical News*, November 19, 1892), backward traction may be applied to the shoulders, the leverage of the brace increased, and greater fixation assured by restraint of unnecessary forward-reaching movements of the arms, which act directly on the weakened spine to increase the deformity.

The jacket is admirably effective as a support in disease of the middle region in adults. It is a better support than the brace in cases of marked deformity and in cases of lateral distortion of the spine. When the neck region is involved the choice between the brace and the jacket is more often one of relative comfort than of other importance. The jury-mast is usually associated with the plaster jacket, but may equally well be used with the brace. In disease of the occipito-axoid region greater fixation of the head than is afforded by the jury-mast is usually indicated; while in the painful distortion of the neck, associated it may be with suppurating sinuses or inflamed glands, the active traction afforded by the jury mast and halter is more comfortable and effective than the simple fixation of the metallic head supports. A disadvantage of the jury-mast is that

it is a very noticeable and rather offensive support. This is a matter of some importance, because head or chin supports are oftener indicated in disease of the dorsal region than is usually taught, not for the relief of pain, but to check the tendency to slowly increasing deformity. In such cases an inoffensive chin rest may be used when the jury-mast would not be tolerated. One may conclude, then, that while the brace and its attachments have a wider range of application, under certain conditions the jacket is more comfortable and more effective.

The faults of the jacket, as it is often applied, are that it is made too short below to support the abdomen, but allows it to bulge out beneath—thus it fails in support and predisposes to hernia; that it is not carried high enough to cover the chest and assure efficient counterpressure; that jury-masts are not applied when they are indicated, are not strong enough to support the weight of the head, and that traction is not properly applied.

FIG. 7.

Most of the spinal braces sold in shops are useless; others are not properly fitted or the aprons are too short or made of yielding material which allows uneven and uncomfortable tension. While either method, properly carried out, may meet all the ordinary indications in treatment, there are occasions when one is distinctly

preferable to the other, or when the appliances may be interchanged with advantage.

The object of mechanical treatment is to free the spine from the influence of local deformity (Fig. 7) and from the deforming influence of the symptoms and complications of disease; to distribute the compensation which is necessary and to limit that which is unnecessary.

The test of an appliance is its efficiency in meeting these indications; the test of treatment is its effect upon the patient.

A NEW PAPER SPINAL CORSET.

By LOUIS A. WEIGEL, M.D.,
ROCHESTER, N. Y.

The corset presented is offered as a substitute for the removable plaster-of-Paris jacket, and possesses certain advantages over one made of leather, felt, or wood. The material of which it is constructed is a wood-pulp matrix paper and linen, and is, of course, made over a plaster-of-Paris cast of the patient's trunk. The plaster cast should be a smooth one, either solid or hollow. The process of construction is substantially the same as that of the wood jacket described by Waltuch,[1] the only difference being in the materials used and the method of finishing. The jacket is made as follows:

A piece of linen, thoroughly dampened, is smoothly stretched on the cast and secured by tacking along a line in the centre of the cast in front, and also at the top and bottom. In subjects with well-developed breasts and hips, the application of the linen will be much facilitated by approximately fitting it to the cast by sewing seams of the proper shape along the axillary lines, after the manner of fitting a dress-waist to the form. The linen thus applied should be free from wrinkles. The paper is saturated with water, and the excess removed by placing it between towels or absorbent cloths. It is then cut into strips of suitable width and length, the size depending upon the jacket to be made. The paste for cementing the various layers together is what is known as Boston steam paste, such as is used by paperhangers, bookbinders, etc. It is applied thoroughly to each piece with a flat brush, but an excess should be avoided.

In applying the paper, the order given by Waltuch for his wood jacket may be followed. The first layer of paper strips is put on

[1] Centrablatt für orthopädische Chirurgie, Jahrg. xi, Heft 1, p. 1.

vertically, the second horizontally. It will be found convenient in putting on the vertical strips to begin in the centre of the back and work in both directions toward the front; and if special strength is desired in the waist line, the vertical strips may be put on in two pieces, allowing them to overlap each other an inch or two in the centre. The horizontal strips should extend across the back to the axillary lines, where they are overlapped by the strips coming from the centre of the cast in front.

After these two layers are applied, a layer of linen, cut into strips of any convenient width, is put on. The linen should always be dampened before application.

The next step is the application of two oblique layers of paper, followed by another of linen. Two additional layers of paper are now applied as the first ones—that is, horizontally and vertically. A layer of linen may be applied as a finish, but this is not necessary. Special points are strengthened by a few strips of paper, applied one above the other, like an elliptical wagon-spring, or by simply crossing them at right angles to each other.

The jacket should be allowed to remain on the cast until thoroughly dry. Artificial heat may be resorted to, to hasten the drying process. Before removing it from the cast, it is perforated with a drive punch. The jacket is removed from the cast by cutting around the upper and lower edges with a sharp knife, and taking out the tacks along the centre and in front, when it may be sprung off. It is then ready for enamelling. There are various kinds of prepared enamels on the market which may be used. Aspinall's bath enamel is perhaps the best, and is applied to both sides of the jacket with an ordinary flat brush. Two or three coats of the enamel should be applied, allowing each coat to become absolutely dry and hard before applying the next. The first coat should be a thin one. The edges of the jacket are then trimmed and bound with kid, and strips of leather provided with lacing studs are sewn on.

The special advantages of this jacket consist in its lightness, strength, and cleanliness. It is unaffected by the heat of the body, and the water-proof enamel prevents the absorption of perspiration. When the jacket becomes soiled it can readily be cleaned with soap and water.

THE ALUMINIUM CORSET.

By A. M. PHELPS, M.D.,
NEW YORK.

Gentlemen: I present this corset to you not as a substitute for many of the braces and corsets now worn in the acute forms of Pott's disease and lateral curvature. I offer it rather to take the place of such braces in cases requiring permanent bracing, or in individuals who are desirous of securing a support at any time which combines durability with lightness and comfort. So soon as a case of lateral curvature has been arrested, or the greatest amount of benefit has been derived from treatment, the aluminium corset will then be found a most agreeable permanent support.

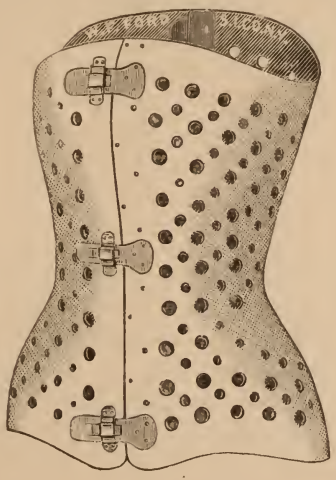
The aluminium corset has these qualities to recommend it to the patient:

1. Lightness.
2. Durability.
3. It is thin and does not interfere with the form and clothing.
4. Being extensively perforated makes it the coolest and most agreeable of supports.
5. The patient can wear it during bathing.

An ordinary corset weighs from one to two pounds, depending upon its size. To prevent cracking and to protect it from perspiration it is covered with a waterproof enamel which is applied by heat.

The steps of its construction. Make a plaster form of the body; send this form to the foundry and have a cast-iron anvil made; polish this, and then at a certain temperature the workman will bend on to it two sheets of aluminium representing the two lateral halves. The frequent heating and hammering together with the cylindrical shape makes the corset almost as strong as

steel. The two halves are hinged in the back, and close with automatic clasps in front, which stop at any notch to accommodate itself to the body before and after eating. This corset completes my armamentarium in cases requiring spinal supports, viz.:



1. Plaster-of-Paris corsets for Pott's disease.
2. The Wood corset for lateral curvature and cured or convalescent cases of Pott's disease.
3. The Beely corset for mild forms of lateral curvature, particularly in girls; and lastly,
4. The aluminium corset for permanent bracing.

A NEW METHOD OF CURING INVETERATE SOFT CORNS BETWEEN THE TOES.

By A. M. PHELPS, M.D.,
NEW YORK.

We all frequently meet with cases of soft corn, occurring particularly in the working classes, between the toes. They are extremely painful, crippling the patient and rendering life almost unendurable. These cases come to the hospital and ask to have the toes amputated. Such corns are usually treated conservatively, and are cured, but immediately relapse. Deep sloughing ulcers are frequently seen.

A simple procedure which I have followed many times during the past few years answers admirably and saves the toe. It consists in removing all of the soft tissues on the inner side of two of the toes, removing the corn, and stitching the two toes together, as seen in the figure. This procedure does not in the least impair the usefulness of the foot; whereas the removal of the toe must necessarily do so to a certain extent.

Patients upon whom I have operated in this manner have expressed themselves as entirely satisfied, and I am certain that if I had a soft corn that caused me much trouble I would have no hesitancy in having the operation performed, and the toes "webbed." The nail of the little toe should be removed.

OBSCURE INJURIES OF THE SPINE FOLLOWED BY PARALYSIS OF LONG STANDING. RELIEVED BY SUSPENSION AND PLASTER-OF-PARIS JACKET.

By LEWIS A. SAYRE, M.D.,
NEW YORK.

Having seen a number of cases of serious injury of the spine followed by paralysis, more or less complete, involving the bladder and rectum, which were relieved by suspension and a plaster-of-Paris jacket, and eventually recovered completely; and two of these patients having recently called upon me in perfect health after the lapse of many years, it occurred to me that it would be desirable to look over my note-books, and publish the records of the cases for the benefit of the profession.

Case I.—C. W. H., about thirty-six years of age. On October 15, 1877, in switching from a main track to a branch, the train going around a curve at a rapid rate, while he was standing in the rear of the car he was violently thrown upon the corner of a stove and instantly paralyzed below the waist, probably by a fracture of one of the lumbar vertebræ, presumably the third. While paralysis of motion was complete at the time, there was some sensation and pain in the outside of the left thigh for a few hours. There was loss of control of the bladder and rectum, with a feeling of constriction, as of a tight band, about the lower part of the abdomen, the line of demarcation between the active and paralyzed parts being clearly defined. Pain at the point of injury was incessant and severe beyond description. The bowels were evacuated by cathartics and clysters, and the bladder by the catheter. After ten weeks there was some return of sensation, with ability to evacuate the bladder voluntarily

as a general thing, and in a little more than five months from the time of the injury there commenced a slight muscular action in the legs, which increased irregularly, so that in a year after the hurt the limbs could be drawn up and pushed down in the bed, and even be made to move as in walking, with the body supported on crutches and by an attendant; but only a trifling amount of weight could be sustained by them.

During all this time there were frequent periods of almost total paralysis of both motion and sensation, greatly influenced evidently by the formation of numerous abscesses, which began about six months after the injury, discharging through the rectum, the outside of the right thigh, and the inside of the left—the latter giving exit to two fragments of bone half an inch to an inch or more in length, and from one to two lines in thickness; one piece from two to three lines in width at the base, tapering to a point, and partly necrosed; the other, from one to two lines wide, somewhat pointed and slightly curved or twisted in shape, but perfectly bright and clean and showing its fracture very plainly. The patient, who was a physician, stated that he was confident that another fragment of bone had previously escaped *per rectum*, while still another was distinctly felt in the abscess that formed in the outside of the right thigh, but afterward disappeared. During the winter of 1878 and 1879 abscesses formed with great frequency, causing much loss of strength through the large quantities of pus formed and the severe pain they created. The partial recovery of the action of the muscles was in a great measure lost, so that they responded to the test of electricity no more than would those of a man recently deceased, and he was unable to distinguish the difference between heat and cold when applied to the surface of the extremities; indeed, so imperfect was sensation that both legs were badly burned on different occasions by too hot soapstones, it being necessary to use artificial heat to maintain the proper warmth in the extremities.

The abscesses finally stopped forming under the use of iodide of potassium, so that after May, 1879, only two appeared, the last about the first of August. With the cessation of the abscesses improvement took place in the general health and in the action of the legs, apparently aided by the daily use of electricity and frictions, and the persistent exercise of the muscles by volition, so that by the

autumn of 1879 he was able at times to get a part of his weight on his feet by supporting himself on crutches or over the back of the chair. But he was still unable to be off the bed except for a short time during the day, and often he did not even make the pretence of sitting up for more than a week at a time. He was compelled to evacuate the bowels by injections except at times when suffering from painful diarrhœa. He also suffered such intense pain in his spine and limbs all the time that he was forced to take from one to three grains of morphine daily to keep even bearably comfortable.

On November 30, 1879, the actual cautery having previously been applied with but trifling benefit, if any, with the assistance of of my son, Dr. L. H. Sayre, I suspended the patient and encased him in a plaster-of-Paris jacket. The relief from pain and the improvement in the sensation and motion of the limbs thus produced indicated the probable benefit which would follow from this mode of treatment.

The jacket was applied exactly as described in my work on *Spinal Disease and Spinal Curvature, etc.*, the closest attention being given to the minutest details. The result was a remarkably accurately fitting case, which gave perfect and even support to the whole trunk, and complete and absolute rest to the injured and diseased parts. Three days later the patient could walk about the room without mechanical support, and two days after this he went on the street for his first walk in more than two years. Sensation, which had been very imperfect, became nearly normal; control of the muscles became constant and much more perfect; the frequent attacks of spasmodic contractions of groups of muscles entirely ceased, as did also the occurrence of almost total paralysis of the legs, during which he would often be unable to draw them up in bed for days at a time. Complete control of the bladder was obtained, and the bowels became much more natural in their action, enabling him to wholly discard injections. He was also enabled to discontinue the use of heat to the limbs, as they had become as warm as the other parts of his body. Though still suffering severe pain at the point of injury, he succeeded, within a period of six weeks, in reducing the quantity of morphine to less than one-half of that taken before the jacket was applied. At this time the muscles were still too weak to sustain the weight of the body with the legs flexed, or to raise it on the

ball of the foot and propel it forward as in natural locomotion. This gave him a necessarily slow and somewhat awkward movement, but there was apparently no paralysis of any muscle at that time, and he was able to walk a fourth of a mile without artificial aid of any kind except the *moral* support of a light bamboo cane.

On removing the jacket, January 13, 1880, he found himself unable to walk across the room without support of some kind, while there was a marked increase of pain. There was also a perceptible change in the form of the trunk, it being two inches smaller around the waist, probably by absorption from lateral pressure of the jacket above the ilia, where it had been crowded in to get a point of support to maintain extension. Upon the application of a new plaster case there was immediate relief of the increased pain, and a return of the use of the legs as before, with considerable improvement in their action, the new jacket being, if possible, a better fit than the first. This showed most clearly the need of, and the great benefit derived from, the extension and support of the plaster jacket.

On February 1st he reported that he could then raise himself on his toes by voluntary contraction of the extensor muscles of the feet.

On March 11, 1880, he called at my office in perfect health. He could walk without cane or other support nearly as well as before the accident. He wore the jacket eighteen months, when he was perfectly consolidated. Since then he engaged in the active practice of his profession until July, 1887, when he died.

Case II.—W. F. C., twenty-nine years of age, was brought to me by the preceding patient, both of them having been injured by an accident on the same railroad. On August 10, 1877, while acting as mail agent, he was in a train which ran off the track and for some distance on the ties, during which time Mr. C. was thrown violently about the car in various directions. This caused partial loss of consciousness for a short time. He was soon, however, in the possession of his faculties, and continued at his duties as mail agent until August 13th. During these three days he suffered severe pain in the lumbar region, where there was noticed a slight swelling and contusion. Four days after the accident he gave up work and took to his bed on account of severe pain in his loins. His bowels had been constipated for three days following the accident, and he had

also experienced considerable pain in his head during this time. On the third day the patient for the first time was unable to voluntarily empty his bladder except while supporting himself by his hands on the arms of a chair or by supporting himself on crutches. This continued up to the time he was first seen by me, January 17, 1880. He was confined to bed for twenty-two months, continuously so for thirteen months, with occasional intermissions of a few moments at a time. Three weeks after receiving the injury he noticed loss of sensibility in both feet, which gradually increased and extended upward until it reached the knees, which was at the end of ten months. The anæsthesia now gradually subsided from the right leg, while it extended upward in the left, involving the whole thigh. During these ten months he was actively treated—local bleeding by means of leeches, blistering, iodide and bromide of potassium in full doses being used. The loss of sensation in the left limb remained unchanged until July, 1879, when he felt sharp pain from the back pass down the inside of the thigh and leg, and while before July, 1879, pricking with needles or the application of a strong current of electricity failed to cause any sensation whatever, he now began to feel a tingling from such operations. Voluntary motion in the left limb became impaired from the first, and at the end of seven months was completely abolished. Voluntary motion in the right leg was never impaired. There had been a total loss of sexual power from the first, though sensation of the genitals had been normal. The pain in the lumbar region was continuous and severe for thirteen months from the time of the injury, but it then began to diminish, and had gradually grown less severe. During these thirteen months the patient was actively treated as before described, and a brace was employed, but owing to the continuous and severe pressure which it caused on the crests of the ilia and under the arms it had to be discontinued. During this time he had been seen by a large number of distinguished physicians in different parts of the country, all of whom considered his case incurable, but thought he might receive some relief.

At the time when he first came under my observation, January 17, 1880, the patient weighed about two hundred pounds, very nearly what he weighed before his injury. His appetite and digestion were good, and the bowels were regular. He slept tolerably well. The right limb was normal; the left incapable of any voluntary motion.

There was some sensation in the limb, so that when a needle was plunged into the patient he experienced a sensation as though his leg had "gone to sleep." The limb was well nourished, having diminished but little in size. There was constant pain in the back, though not very severe. Pressure over the first and second lumbar vertebræ caused an increase in the pain; crowding the vertebræ together, by pressing on the head or shoulders, increased the pain in the lumbar region, while when the superimposed weight was taken off by suspending the body by the shoulders, the patient felt perfectly easy. He was unable to sit erect longer than fifteen or twenty minutes without suffering violent pain and great exhaustion. When he supported himself on his crutches he felt very comfortable, and could remain so for an hour or more. The urine could not be voided except when the patient suspended his body from his shoulders by means of his arms or hung upon his crutches.

He was to-day cupped over the lumbar region, and about four ounces of blood obtained, deep punctures by means of a sharp tenotome being employed instead of scarification.

January 23*d.* Sensibility of the left limb has increased since the cupping, and the pain on pressure in the lumbar region has diminished. The actual cautery was applied on each side of the lumbar spine over the transverse processes for about three inches.

February 3d. Suspended the patient and applied a plaster-of-Paris jacket. When it had set he could stand without other support, which he had not been able to do since the accident. Sensation has returned to the left leg since the application of the cautery, and he can now slightly move the toes voluntarily.

March 16*th.* A letter was received in which the patient said: "Sensibility and motion are returning rapidly; the former is now nearly perfect. All the muscles now respond to the battery."

May 26*th.* Patient returned. Sensation and motion greatly improved. He can now walk with the assistance of a cane. The jacket was removed and made into a corset. There was no tenderness on concussion or pressure along the spine. He could stand erect without any support.

September 20*th.* He has been in perfect condition since last note; he can now stand without pain or support.

March 23, 1881. Mr. C. returned to-day in apparently perfect

health, but he states that he cannot yet do without the corset for any length of time. In December, 1880, he first attempted to do without it, and he became much exhausted after a few moments. He has, however, gradually increased in strength, so that he can now leave it off for a whole day, provided he does not walk or exert himself. The genital organs still remain powerless—no sexual desire or erection. He can pass his water easily when the jacket is off.

November 9, 1881. He returned in perfect health except as regards his sexual organs. He has not worn a jacket since last July, having worn a jacket for nineteen months.

June 26, 1886. Patient looks perfectly well; weighs 205 pounds; says he cannot lift any weight without feeling it in the back. The numbness in the feet has entirely disappeared; sexual power has returned, but there is no desire.

August 2, 1893. The patient called to see me as he was passing through town with his wife and three-year-old son. He was in perfect health, sexually as well as otherwise. He frequently rides sixty miles a day on horseback without suffering any pain or fatigue.

Case III.—Mr. O. E. B., fifty-three years of age; in June, 1879, was standing up in the rear car of a train when it jumped the track and ran on the ties for some distance and then turned over. When he was removed from the wreck he had severe pain in the lower part of his back and no sensation in his lower extremities. The lower extremities were entirely motionless and cold. The right external malleolus was torn off, and he received various other bruises about the body. The bladder failed in its functions after the accident and the urine had to be withdrawn by catheter. The bowels became costive and required to be moved by cathartics. Digestion remained good and appetite fair. It was supposed by his medical attendants at that time that there had been a dislocation of the eighth or ninth dorsal vertebra, which was pressing on the cord.

He suffered great pain and loss of sleep. On the fourth day sensation began to reappear in the lower extremities, and this soon developed into a hyperæsthesia. This hyperæsthesia also affected the upper part of the body. He did not suffer from severe pain in the spine at this time. After the tenth day the bladder resumed its function. On the third or fourth day, after many trials, he succeeded

in moving the second toe of his left foot slightly, and from this time motion gradually but very slowly developed in other parts of his lower extremities, and in the course of a few weeks he could extend the leg a little upon the thigh. A slight slough occurred on the left heel. The lower extremities remained very cold and had to be kept warm by hot bottles and the use of friction, etc.

In September he first rode out in a carriage, but while riding could not be comfortable except when supporting himself on his arms, and each time when he came home he felt so very tired and exhausted that he was finally obliged to give up this exercise.

On October 30th a felt corset was applied to him. This made him feel much better and gave support to his back. With this on he again rode out, and with more comfort. The right foot and leg remained somewhat painful. The right thigh was atrophied, measuring one and a half inches less than its fellow.

In the latter part of December he began to bear some weight upon his legs, and could, when first seen by me in March, 1880, bear his whole weight on his limbs after he had been helped to the upright position. While sitting up he had a frequent desire to raise himself upon his arms. He could flex the thighs moderately and the legs upon the thighs. The left leg had more power than the right.

The tenth and eleventh vertebræ were more prominent than the others. The spinous and transverse processes were more prominent and much thickened, and on firm pressure considerable pain was produced. Below this point there was more than the ordinary lumbar lordosis. Sensation was still a trifle exaggerated below the tenth and eleventh dorsal vertebræ, except in the left foot, where there was partial anæsthesia. On touching the sole of the right foot an immediate reflex muscular movement followed, while in the left, reflex movement was considerably delayed, and the foot then moved very slowly. When sitting up for any length of time he supported himself by leaning on his arms, which he said "rested him." He had to be assisted to his feet, after which he could stand by supporting himself somewhat on his crutches. By being raised so as to take most of his weight from his feet he felt better than when standing. After being supported in this way for some moments he felt, when let down again, tender and uncomfortable along the lower part of his back.

About five or six ounces of blood were drawn from the lower dorsal region by means of deep incisions and cupping-glasses.[1] The next day the patient voluntarily remarked that his thighs felt different, and that he could move these muscles voluntarily, which he had not been able to do since the accident. The actual cautery was applied on the right side opposite the tenth dorsal vertebra, and on the left side opposite the fourth lumbar vertebra. When the burns of the cautery had healed a plaster-of-Paris jacket was applied, from which he experienced some relief from the constant aching in his back, but not complete freedom from pain. He was able to move his extremities more freely, but the jacket did not give him the expected and desired relief to his pain and improvement in muscular strength, and it was evident that too much "dinner pad" had been used, and sufficient "waist" had not been made to the jacket. This jacket had been applied while he was sitting on a stool and partially suspended from his head and axillæ. A second jacket was applied while the patient was suspended from his head and arms while standing upright, the extension being carried to the point of making the patient comfortable. Great care was used in "waisting in" the jacket, and in this better fitting jacket he had very little pain in his back and was able to walk very much better. He said it gave him very great support.

Six months later he wrote that he was improving surely, but, as he thought, very slowly. The right leg continued to be one and a half inches smaller than the left, and had much less power, although it could bear the whole weight of his body. The left leg was strong but sluggish. The circulation continued to be slow in both lower extremities. He used his crutches in going out-doors, but in the house he could get about with two canes, and could take a few steps without support. He also thought he had improved more in the last four weeks than in the preceding few months.

In December, 1881, he called on his way to Europe; walked up stairs without assistance except his cane and his hand on the baluster. He could walk on the level ground without jacket or support, and could concuss himself on his heels without pain, but pre-

[1] In all of these cases the blood was withdrawn from punctures made very deeply along the spine and not from superficial scarification—a point which I think is of much importance in cases of congestion of the spinal cord.

ferred to wear the plaster jacket for protection. He could cross each leg over the other, but did this better with the left than with the right; he had voluntary control over the muscles of his lower extremities. The left leg is more tardy in its movements, although it is the largest. A plaster-of-Paris jacket was applied and made into a corset, and with this he sailed for Europe.

In 1887 he reported that he had steadily improved, although his legs were still slow in responding to his will. He was still using massage and Swedish movements.

In February, 1892, he called and stated that he had been able for some years to walk up and down stairs without assistance, and was in perfect health and attending to active business, but was unable, while lying down, to rise from the floor without assistance.

The patient was seen in June, 1893, and his back continued well.

Case IV.—L. V. T., about twenty-eight years of age; while in charge of an express car, in May, 1886, the train was derailed and fell down an embankment into Lake Champlain, the car turning over several times and the iron safe striking the patient violently a number of times. He was rendered partly unconscious by the fall, and when he came to himself was unable to move his lower extremities. He has had very defective control of his bladder and bowels since the time of the injury.

When first seen, in 1886, some months after the injury, he was still paralyzed as to motion and sensation in the lower extremities, bladder, and rectum, but not completely so, as he was able to drag himself about on crutches, but was unable to rise without assistance. He had severe pain in the lumbar region and the sensation as of a girdle around the waist. While partly suspended by the head and shoulders he could move his legs with greater ease and the girdle sensation disappeared, and with a plaster jacket could sit upright for several hours without discomfort. When unsupported by the jacket he had constant pain in his back, and was unable to sit erect for more than a few moments. Plaster jackets, applied while the patient was partly suspended by the head and shoulders, were renewed at intervals of about six months for a period of two years. The patient recovered control of his bladder and rectum in about eight months,

and was able to walk with the aid of a cane in about a year, and at the end of two and a half years was perfectly well. On applying to the express company for information as to his present condition, I received a reply on August 21, 1893, saying: "Mr. T., referred to in inclosed correspondence, is to all appearances in perfect health.

There are certain points of similarity in all these cases upon which I wish to dwell with special emphasis. They all remained more or less completely paralyzed for long periods after the receipt of the injury—in one case over two years—and marked improvement did not begin until traction was made on the spinal column. In every case, when the spine was stretched, the patients said they felt better; they had more control of their limbs and sensation was keener. In one case the patient was unable to evacuate the bowels or bladder except when the superincumbent weight of the body was lifted off. All of these cases continued to feel this improvement as long as they were *properly* sustained by *properly* fitting plaster jackets. When the support became broken down and failed to retain the spine in its stretched position the symptoms began to return, to disappear again on the reapplication of the stretching and retention of the spine in this position by an accurately adjusted support.

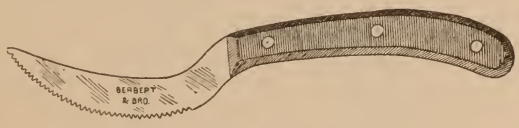
A SPLINT-OPENER FOR PLASTER-OF-PARIS SPLINTS, AND OTHER SIMPLE DEVICES.

By HARRY M. SHERMAN, M.D.,
SAN FRANCISCO, CALIFORNIA.

These forms of apparatus are such as I have been using in my orthopedic service at the Children's Hospital in San Francisco, at the Orthopedic Clinic of the San Francisco Polyclinic, and in my private practice. I think that they are novel, or contain novel features.

The splint-opener for plaster-of-Paris splints consists of a saw and an opener. The saw is modelled chiefly after one I bought in New York, but altered in that the handle is put on a higher level than the

Fig. 1.



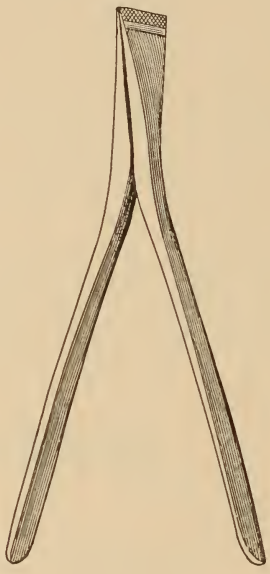
Plaster splint saw.

blade by the two elbows. The back of the saw-blade is ground down to a knife edge for about an inch back from the point. Ten teeth to the inch has been found to make the best saw. The opener consists of two blades and handles joined so that, when the handles are approximated, the blades are separated. The blades, when in contact, will just fit in the cut made by the saw and are held from slipping on the plaster by little serrations.

I always line my plaster-of-Paris splints with cotton wadding, which is found in the shops in sheets. To open a splint it is sawn from end to end in the most convenient place, the cotton-wadding lining thoroughly protecting the skin from injury, after the plaster

is penetrated, by wrapping around the teeth of the saw. Into the cut of the saw the opener, with blades in contact, is inserted, and by approximating the handles the blades and splint are opened. In the case of unusually thick and hard splints this method is especially applicable, and in splints that are taken off but to be replaced, it is possible, by a little care, and opening them a little at a time through the whole length of the saw cut, to prevent destructive injury to the splint.

Fig. 2.



Splint opener.

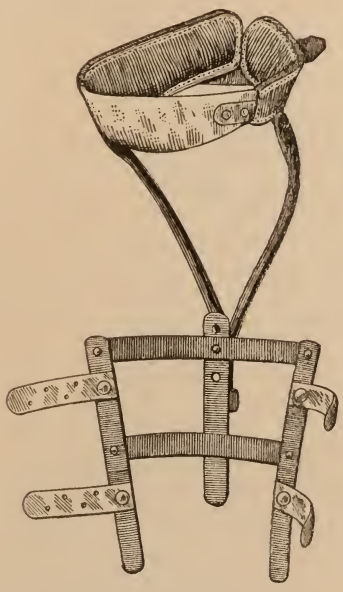
As regards the most convenient places for sawing the splints: on the upper arm the cut should be along the external surface, and if the splint is a spica of the arm and trunk, a second cut must be made through the trunk portion under the arm of the opposite side; on the arm and forearm the cut should be along the posterior aspect of the arm, over the tip of the elbow, and along the ulnar border of the forearm; on the forearm and hand it should be along the radial border of the forearm and hand and thumb, and the outer side of the forefinger.

In splints of the lower extremity, a spica of thigh and pelvis should be cut down the inner aspect of the thigh, and the pelvic

portion over the ilium of the opposite side; on the thigh and leg the splint should be cut down its outer aspect; all splints that take in the foot should be cut down their posterior aspect and then along the sole of the foot.

In cases of vertebral tuberculosis, when carriage of the head is necessary, I have found the aluminium chin-collar and steel fork the

Fig. 3.



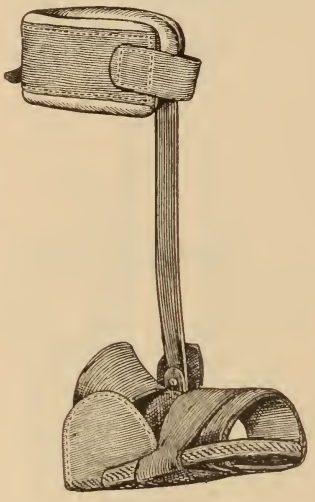
Aluminium chin-collar and fork.

most satisfactory. Aluminium, the ordinary commercially pure aluminium, is light, strong enough for the purpose, and clean, the process of oxidation, which is inevitable, taking place very slowly. The joint between the collar and the fork is placed a little below the level of the occipito-atloid articulation, to coincide more nearly with a common axis of flexion for the cervical articulations. The fork is modelled so as to lie as close to the shoulder as possible and yet not touch it. In fitting the aluminium a Barton bandage of plaster-of-Paris is put on the head, and this, when hardened and removed, gives a perfect negative of the chin and occiput, from which a posi-

tive in plaster-of-Paris is made, and then, on this, the aluminium is moulded and the steel side straps are fitted. The fork is of malleable steel and the final adjustment is made by wrenches.

The difficulty I experienced in keeping night-shoes on children under treatment for talipes has been overcome by such a disposition of the straps as gives half of a clove hitch around the ankle. The crossing of the straps is at the inner side, and so leaves the posterior tibial vessels uncompressed. The metatarsus and phalanges are held

Fig. 4.



Night shoe.

on the steel sole-plate by a broad leather strap or bandage which crosses from the outer side over the bases of the toes, and passes through a slot and returns obliquely across the metatarsus to the outer ankle. Once properly adjusted this shoe cannot be kicked off during the sleeping or waking hours of the wearer. Occasionally, when it is desirable, I have the steel sole-plate extend only to the base of the toes, and the sole, from there on, made of two thicknesses of leather riveted together, and then use the night-shoe, inside an ordinary leather shoe, as a walking-shoe.

The form of varus walking-shoe I have been using for the past six years I find has been described and illustrated by Dr. B. E. McKenzie, of Toronto, in Vol. IV. of the TRANSACTIONS of this Society. It is essentially a spring-heel shoe, the outer border of the sole being considerably thicker than the inner—so as to throw the foot into a valgus position—and with the counters extending past the metatarso-phalangeal articulations on both outer and inner side to

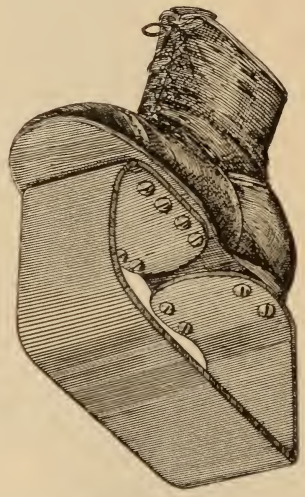
FIG. 5.

Varus shoe and outrigger.

keep the metatarsus and phalanges in line with the tarsus. In some obstinate cases where the foot still shows a tendency to roll over on the outer edge, I have added a little curved strap of steel, set flush with the sole and extending out beyond the outer edge, like an outrigger. This outrigger very effectually checks the tendency to roll over, and can be worn with no inconvenience until joint surfaces are readjusted in their normal relations and the tread is easily plantigrade.

My instrument-maker, Mr. Berbert, a graduate of the shops of Otto & Sons, in New York, tells me that he never saw made there a lift on the model I use in San Francisco. I remember that I got it from a patient of mine, who wore it into my office in place of the one I had had made, and which had broken, the new one having been made for him by a friend, a mechanic. This is made of a single piece of sheet steel, of thickness adapted to the weight to be carried, and turned upward at the toes and heel and then backward and forward under the sole of the shoe. In the cases of heavier children who

FIG. 6.



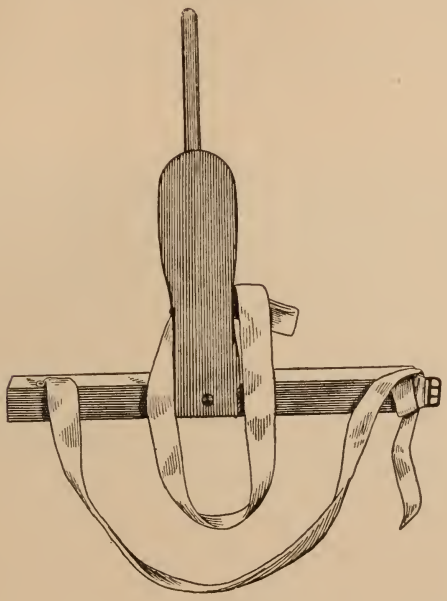
Patten or lift.

romp, the shank of the shoe requires special support of a steel strap, which is fastened in front and behind to the toe and heel plates of the lift. The apparatus gives a thoroughly stable basis of support, and there are on it no corners or projecting points that can catch in carpets or rugs and cause falls.

In the treatment of hip-joint disease by traction in bed, or in the treatment of cases after resection of the hip, or in any case where there is a tendency to rotation outward or inward at the hip, this foot-holder is useful. It is merely a sole of wood fastened, by its heel, at right angles to the middle of a slat of wood about ten inches

long. The sole is strapped to the foot by webbing, somewhat as the old-fashioned skates were strapped on, and the slat lying on the bed prevents any rotation of the limb. The peg projecting from the toe of the wooden sole is to hold the bedclothes up from the foot.

Fig. 7.



Foot-holder.

The fastening of webbing and plaster and buckles *et id genus omne* is a tedious process by needle and thread, and the eyelets ordinarily used weaken the material by cutting threads. The simplest way is by steel wire staples fastened by the McGill single stroke staple press, such as can be bought at any large stationer's store, and is intended for fastening manuscripts and pamphlets. These staples are easily adjusted, hold firmly as long as they are needed, and then are removed with little difficulty.

A CASE OF CONGENITAL TALIPES CALCANEUS.

By F. S. COOLIDGE, M.D.,
CHICAGO.

In August, 1893, Dr. F. S. Churchill asked the writer to see a baby, of which he had delivered the mother seven days previously, and whose feet were in a position of extreme dorsal flexion, so that the toes were resting against the tibiæ.

The history of the pregnancy was uneventful, and the delivery of the child was short and easy, the head presenting. There was no history of any deformity in the baby's family.

Examination disclosed a healthy child, well formed except for its legs. The knees were slightly flexed, and could not be completely extended without the use of considerable force. The feet were habitually held close up against the tibiæ, although the child could move them slightly downward from this position. Pulling the feet downward slightly in the direction of plantar flexion brought out the rigid contracted tendons of the anterior tibial, the common extensor, and the extensor of the great toe, although in the habitual position these tendons did not present. The calf muscles were flabby and the Achillis tendons lax.

The fact that the feet were habitually held in greater flexion than the contraction of the anterior tendons warranted led to a careful examination of the ankles. The external malleolus bulged out the skin well down on the heel and quite a distance posterior to the whole foot. The same was true of the internal malleolus, though to a less extent. This gave the appearance of a complete dislocation of the foot forward and slightly upward. Lateral motion at the ankle was freer than normal, though not excessive. The skin over the ankle was wrinkled but not webbed.

The feet themselves were well formed, with the exception of the flat foot common to infants, and the writer was unable to make out the deformities of individual bones which Messner found in a similar case which came to dissection.

Ten days later the child was photographed, and the accompanying pictures were taken. The deformity was the same, except that the habitual position of the feet was not such extreme flexion as at first. The contraction of the tendons, however, was unchanged.

Fig. 1.

Habitual position at birth.

In order that the probable abnormality of the bones might not become permanent by growth in the abnormal position, the child was lightly etherized when twenty days old. After twenty minutes of forcible manipulation, with careful protection of the lower epiphyses of the legs, the contracted tendons were carefully stretched until an over-corrected position was secured, and with slight pressure was easily maintained. Tenotomy was unnecessary.

Although the flexion was overcome, the foot, if left to itself, remained one inch further forward upon the leg than it should, owing to the lax condition of the ligaments of the ankle-joint. This partial dislocation of the ankle forward was more marked with the foot at a right angle than before the flexion was overcome. As the external ligaments were looser than the internal, the foot rotated in somewhat. The dislocation was easily reduced, but as easily

recurred again unless the foot were held. The condition was the same in both feet.

Plaster-of-Paris bandages were applied extending upward over the bent knee, and they held the feet in excellent position.

The points of interest about the case which seemed to the writer to make it worth reporting are:

1. The rarity of reported cases of extreme congenital calcaneus.
2. The dislocation of the feet forward.
3. The etiology of this case. The feet habitually lay flexed against the tibiæ, and in this position the anterior tendons were lax.

Fig. 2.

Habitual position seventeen days after birth.

It was only when the feet were extended somewhat that the contraction of the tendons became manifest. Therefore the deformity was not due to the active contraction of the anterior muscles, from irritation, central or peripheral, nor to their secondary contraction following a temporary paralysis of the posterior group. It must have been due to conditions *in utero* which forcibly held the feet in this position, and to which the tissues of the legs adapted themselves. As a proof of this may be urged the fact that seventeen days after

birth, and after those powerful conditions *in utero* had been removed, the habitual position of the feet was no longer flexion against the tibiæ, but as near the normal as the contracted anterior muscles would allow.

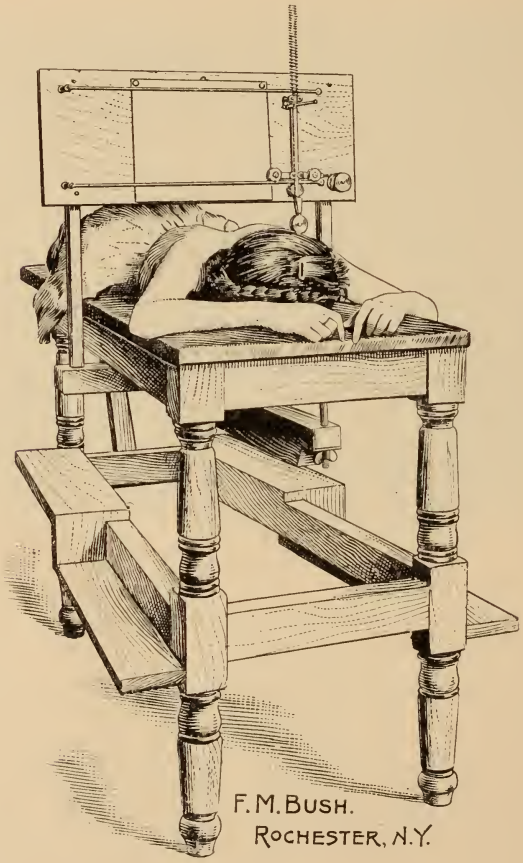
4. The comparative ease with which the contracted muscles and tendons of infants can be stretched by careful manipulations without the use of the tenotome.

APPARATUS FOR RECORDING THE CURVE OF ROTATION IN SCOLIOSIS.

By L. A. WEIGEL, M.D.,
ROCHESTER, N. Y.

The apparatus presented is designed to afford a ready and accurate means of recording rotation. It is mounted on a thin board,

Fig. 1.



which is to be placed in any convenient way, vertically, over the patient, as shown in Fig. 1. The apparatus (Fig. 2) consists of two parallel rods A A, upon which the trolley B moves horizontally,

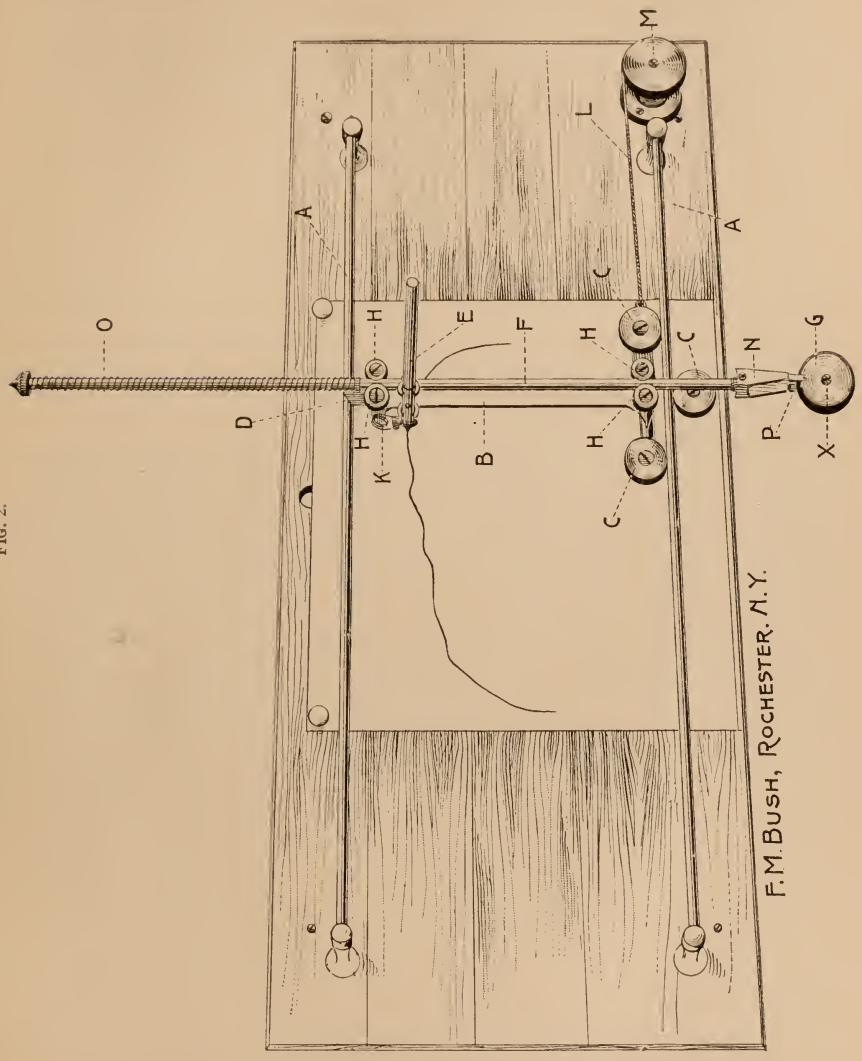


FIG. 2.

guided below on A by three grooved rollers C C C, and above by a fork D, which clasps the rod A. To the trolley is attached a pencil E, which is held against the paper by a light spring K, and is

readily drawn away from contact with the paper, when the machine is being brought into position for starting. The vertical rod F ends below in a fork N, which carries the roller G. This roller is so constructed that it may revolve upon its own axis X, and also to allow it to swing around the pins P as a centre. The movement of the rod F is guided by the rollers H H H H. The movement of the whole mechanism across the board is controlled by a drum M, which contains a spiral spring, and winds up the cord L, as the tracing is being made. This, together with the helical spring O, which controls the vertical movement of the rod F, renders the apparatus almost automatic in its action, it being necessary only to guide the roller G across the patient's back. The marking pencil takes the horizontal movement of the trolley B, in combination with a vertical movement derived from the rod F, which moves up or down as the roller G passes from left to right, and thus gives an accurate reproduction of the surface over which it runs.

In using the apparatus, a piece of paper or thin white card is attached to the board by means of thumb tacks, the pencil being held away from the paper until the trolley with its attachments is drawn across to a proper position for starting. The whole mechanism is so simple in its action that but a few seconds are required to make a tracing.

In recording rotation, it is advisable to make tracings at different portions of the back, and to note the special vertebræ over which they were made. Tracings from corresponding points may then be compared from time to time.

THE TREATMENT OF LATERAL CURVATURE BY MEANS OF PRESSURE CORRECTION AND GYMNASTICS.[1]

By LOUIS A. WEIGEL, M.D.,
ROCHESTER, N. Y.

The treatment of lateral curvature of the spine by gymnastic exercise alone, or combined with mechanical support, has, after extended trial, been found unsatisfactory and disappointing in the more advanced cases. While it is true that the gymnastic method gives better results than the treatment by mechanical support, we must recognize the fact that it has its limitations, and is in reality of positive value only, as an exclusive mode of treatment, in a small proportion of selected cases of the milder type, and particularly when noticeable bony changes have not yet occurred. The value of gymnastic exercise as an adjuvant, however, is well established.

In the more advanced cases all structures involved have undergone a marked change; bones have become distorted, ligaments and muscles are contracted and shortened to such an extent that an attempt on the part of the patient to assume a normal attitude by voluntary effort is a physical impossibility. Special forms of muscular exercise may tend to stretch contracted tissues to a limited extent, but they are not capable of exerting a direct and adequate correcting influence upon the fundamental factors of the distortion.

It is apparent that as long as a spine is held firmly fixed in its distorted position, restoration of form is out of the question. Our efforts, therefore, must be directed toward increasing the flexibility of the spine in every possible way. This principle of treatment has been recognized for some time, but the means employed to bring about the desired result have not been adequate.

[1] This paper was illustrated by a series of lantern slides.

The comparatively recent introduction, or, as some may claim, revival, of pressure correction, offers us a more efficient and promising method of treatment than any heretofore proposed and practised. By the use of a properly constructed apparatus and intelligent application of the corrective force, we are enabled to overcome ligamentous and muscular shortening and perhaps even transform the distorted vertebræ.

The special form of apparatus to be used may be largely a matter of individual choice and convenience. Machines for pressure correction have been devised and described by Hoffa,[1] of Würzburg; Schede,[2] of Hamburg, and Bradford and Brackett,[3] of Boston. The apparatus shown in the first slide is a modification of the above and embodies such improvements as practical experience suggested. Its range of adjustment is such as to permit of its use on patients of all sizes and ages.

The machine consists of a steel frame eight feet high and thirty inches wide, made of rods three-quarters of an inch in diamater, two on each side, three inches apart, connected by two tie-pieces, and ending below in iron legs. The upper curved segment telescopes into metal sleeves and may be secured at any point. Upon the vertical parallel rods two metal blocks slide, which may be securely clamped at any height. The lower blocks carry a mechanism, adjustable laterally and antero-posteriorly, for fixing the pelvis. The counter-pressure bar, to be placed in the axilla on the concave side, is held in position in one of the upper blocks. Between these blocks the semicircular steel bands that carry the pressure-screws and anterior shoulder-piece are placed, one in front and one behind. The anterior band is pivoted so that it may be swung open for the purpose of placing the patient in the machine. Upon the steel bands, sliding clips are placed for holding the vertical rods which carry the pressure-screws, and the anterior shoulder-piece. The pressure-plates are attached to the distal ends of the screws in such a way as to permit of a certain amount of play, so that they may adapt themselves readily to the selected point of pressure. The upper part of the apparatus is provided with ad-

[1] Zeitschrift f. Orthop. Chirurg., 1891, Band i., Heft 1, p. 80.
[2] Deutsche med. Wochenschrift, Leipzig, 1892, xviii. p. 249.
[3] Boston Med. and Surg. Journal, May 11, 1893.

justable hand-pieces and an ordinary suspension arrangement. All adjustable parts of the apparatus are firmly secured in position by capstan-head screws, which obviate the use of a wrench or other tool.

The manner of placing the patient in the machine will be readily understood by reference to the picture on the screen. Suspension by the head is resorted to in connection with the apparatus, principally to overcome the mechanical disadvantage of superincumbent weight. The apparatus is used daily, the patient being subjected to pressure for from twenty minutes to half an hour. In the beginning it is usually advisable to make lighter pressure for a shorter time until the patient becomes somewhat accustomed to it. It is quite remarkable to note the great degree of pressure that may be applied with comparatively little discomfort to the subject after a few weeks.

It is a matter of considerable importance to apply the pressure in the proper direction, for the degree of correction, or over-correction, is largely determined by the angle of pressure. Thus, if the plates are applied so as to make pressure directly from behind forward, the side of the trunk is simply pushed out in front and no corrective force is exerted at all; whereas, when pressure is made in the proper direction a distinct rotary effect is obtained. It is usually advisable to place the posterior pressure-screw directly over the apex of the convexity, in a direction corresponding to the oblique diameter of the chest, the anterior screw being placed at an opposite point in front.

It must be remembered that our aim is not simply to compress the chest-walls. A thorax lengthened in one of its oblique diameters by reason of the lateral deviation and rotation of the vertebræ, to which the ribs are attached, cannot be made to approach a normal form except by applying force in a manner calculated to overcome the primary cause of the distortion. That this may be done in the apparatus is susceptible of demonstration. When pressure is properly applied, the spinous processes will be found to assume their natural position in the median plane of the body (except in very resistant cases), while the lengthened oblique diameter of the thorax is shortened, as shown by measurements with a pair of calipers.

Special rules for the use of the apparatus cannot well be formu-

lated, as every case demands individual study. Sometimes it is necessary to use two posterior screws, especially when there is a marked double curve. Some patients feel more comfortable by placing an extra plate against the sternum.

Inasmuch as the apparatus is resorted to principally to stretch contracted tissues, and as pressure can of necessity be applied for a limited time only, it follows that some means must be employed to maintain the degree of correction as thoroughly as possible. Experience has shown that no form of mechanical support is so efficient as the plaster-of-Paris jacket or its substitutes. Various modifications of the application of the jacket have been proposed for the purpose of securing a *corrective* force, in addition to the mechanical support it affords. The best method of securing this desired result is perhaps not fully determined. Bradford and Brackett's plan of applying a fixed jacket while the patient is in the apparatus is an excellent one; although, as they state, there is some danger of making too much pressure if great care is not exercised.

In making removable jackets I have recently tried a method that promises to be of value. Several patients stated that they felt straighter after having been in the apparatus for a certain length of time, and it was also noted that the correction obtained by pressure was not immediately lost. Taking advantage of these observations, I place the patient in the apparatus under considerable pressure for half an hour, and immediately after taking them out, apply a plaster jacket which is cut off and made into a removable corset. I have found that by so doing a jacket is obtained that makes considerable pressure on the convexity of the curvature, and maintains the effect secured in the apparatus, to a considerable extent. A jacket made in this way is slightly more uncomfortable on account of the pressure exerted, but in the course of a few days the patient becomes accustomed to it.

In the beginning of treatment it is not necessary to resort to mechanical support at once. It is better to use the pressure apparatus alone for two or three weeks, at the end of which time the flexibility of the spine will be greatly increased. A jacket then applied will hold a patient in a better position than if it had been made when the spine was still in its original distorted condition.

It has been the custom to allow patients to dispense with mechanical support at night; it is a question, however, whether this is not an erroneous practice, at least in the more advanced cases. When we reflect how many hours are spent in sleep and that faulty attitudes are assumed in bed even more readily than during the day, the necessity of securing proper positions during recumbency becomes apparent. Restraint during the night, however, proves more or less irksome to the patient, whatever plan may be adopted, and it is exceedingly difficult to select a method that will be tolerated. Perhaps the simplest way to prevent vicious attitudes is to have the jacket worn at night as well as during the day.

The value of gymnastics as an adjunct to more direct and active treatment is well established. After the flexibility of the spine has been restored by stretching contracted fascia, ligaments, and muscles, much may be done by properly selected exercises toward bringing about and maintaining normal static conditions. While it may entail considerable labor on the part of the physician either to supervise or personally give the treatment, yet I am satisfied that the personal attention thus given will in the end be found the most satisfactory. To depend upon prescriptions for gymnastics to be carried out at home I find is exceedingly unsatisfactory. The multiplicity of the duties of the mother, and the lack of appreciation of the importance of being methodical and persistent in carrying out instructions on the part of the patient, render it more than probable that the gymnastic treatment at home is systematically neglected.

It has been suggested that the gymnastic treatment of scoliotics be entrusted to teachers of physical culture. I do not, as a rule, consider this advisable, particularly when, as is often the case, such patients receive no individual attention, and simply do class work. For several years past I have given personal attention to every detail of treatment, including gymnastics, believing that the constant supervision possible by this plan enables one to obtain the best ultimate result.

The series of movements depicted in the illustrations[1] are especially intended to sustain the effect of pressure correction. A num-

[1] Lantern-slide illustrations.

ber of them are calculated to stretch the contracted side and help to increase the mobility of the spine. It is not necessary to have an elaborate outfit of gymnastic apparatus to give a sufficient variety of the exercises. I have devised a useful apparatus that does not require much room and is simple in construction. It consists of a rectangular frame four feet wide and eight feet high. The uprights are about four inches square and are bolted to the cross-pieces. The uprights are slotted throughout nearly their whole length and provided with holes, one inch in diameter, for receiving pegs for a peg-ladder. These pegs are simply inserted into the holes; they maintain their proper position by a shoulder turned on them. The pegs are removable, so that the distance between them may be increased or diminished, and also serve the purpose of securing any cross-bar that may be put into the frame at any height. The cross-piece is provided with a hook for the ordinary head-suspension apparatus. On the face of the cross-piece four pulleys are screwed for carrying the ropes to which a swinging trapeze is attached. The base of the frame is provided with a pair of roller-skates, from which the rollers have been removed, fastened to a secondary board which may be firmly fastened with a thumb-screw running into a nut secured underneath. This frame, together with a set of chest weights, padded table, and Taylor's oblique suspension apparatus, enables me to give a number of exercises in all kinds of cases.

The following are illustrative cases:

Case I.—Girl, aged sixteen years; high dorsal curve to the right, compensating curve in the lumbar region; spine very rigid, rotation extreme. She had been treated for a year by the family physician with plaster-of-Paris jackets alone, in spite of which the curvature rapidly increased. Treatment by gymnastics, active and passive, and removable plaster jackets resulted in increasing the flexibility of the spine somewhat, but no marked gain was made until systematic pressure correction was resorted to. Owing to the extreme bony deformity in this case perfect restoration is not to be expected. This patient suffered almost constant pain before treatment was begun, which has been rapidly and permanently relieved.

Case II—Girl, aged seventeen years; left lumbar curve; patient under weight and above average height; anæmic and poorly nour-

ished. She was treated by an instrument-maker with a steel brace, the pressure-pads and straps being applied to the *concave* side. The brace was exceedingly uncomfortable to wear, and the curvature increased. Right hip prominent, left shoulder drooped. Under treatment by pressure correction and gymnastics there has been marked and permanent improvement; the shoulders are level, and the hips nearly symmetrical. Case still under treatment.

Case III.—Girl, aged thirteen years; an exceedingly anæmic and poorly nourished subject. This was one of those unfortunate cases in which the deformity increased in spite of faithful and systematic treatment by gymnastics and retention corsets. The lateral deviation and rotation are extreme. Active treatment by pressure correction and gymnastics was begun in June. The general health rapidly improved, and the child is now feeling unusually well and the anæmia has entirely disappeared. This patient is able to endure greater pressure for a longer time than any I have treated, and perhaps it is for this reason such a marked change in her form has been brought about. Still under treatment.

Case IV.—Girl, aged twelve years. After an attack of whooping-cough the curvature began to develop, and rapidly increased. General health poor; chest contracted. Under the ordinary gymnastic treatment a distinct gain in the attitude was observed, but it was not until pressure was systematically applied that there appeared to be any permanent improvement. The bones of the trunk of this patient are unusually pliable and the spine very flexible. The mother objected at all times to having any mechanical support applied, and I feel satisfied a much better result could have been obtained had this been done.

Case V.—Girl, aged thirty years. At the age of sixteen, after an attack of typhoid fever, the spinal curvature began to develop, and reached an extreme degree in about two years. She is now suffering much pain and is very uncomfortable. Obtains perfect relief when subjected to severe pressure, and expresses herself as feeling better in the machine than at any other time. She is so

unfortunately situated as not to be able to follow out any systematic plan of treatment.

Case VI.—Girl, aged twelve years. Poorly nourished and anæmic subject. She had an attack of scarlet fever in the spring which appeared to hasten the development of the curvature. On account of very defective thoracic development, gymnastics with special attention to respiratory exercises were given, with the result of markedly increased chest capacity in a very few weeks. This improvement also had a marked effect upon the anæmia, so that now she is in excellent health. There has been a rapid improvement in the spinal curvature and complete restoration seems probable. Case still under treatment.

All of these cases except Case IV. are wearing removable plaster-of-Paris corsets.

From a careful study of cases under observation, it would appear that a marked permanent improvement may be looked for in nearly every instance; and that the degree of correction possible is largely determined by the length of time treatment is faithfully and systematically carried out. The age of the patient and the length of time that a curvature has existed are of some importance in prognosis, yet I do not hesitate to say that under the plan of treatment advocated, a relatively better one may be given than would be justifiable under the methods formerly employed.

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